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December, 1960

JAN 11 1961

# The Mining Magazine

VOL. 103 No. 6.

LONDON.

PRICE: 3s.; With Postage 3s. 8d.



## Geographical surgery for Europe's new artery

THE seven mile road tunnel being driven through Mont Blanc, Europe's highest mountain, will shorten the motorist's journey from Paris to Rome by 124 miles. It will be the world's longest road tunnel, providing an Alpine link—open all the year round—between France and Italy. No longer will the snowbound roads of the mountain passes be a barrier to European communications and trade.

The Mont Blanc tunnel will take three years to complete and will cost an estimated £11,700,000. About four miles of the tunnel are being driven from the Italian side and the

contractors, Società Italiana per Condotte d'Acqua, are using Atlas Copco equipment exclusively. Atlas Copco compressors, rock drills and Sandvik Coromant drill steels have been chosen for this project, regarded as a major contribution towards the unity of Western Europe.

The Atlas Copco Group of Companies is responsible for the manufacture of compressed air equipment and its distribution and servicing in 90 countries throughout the world. Group Headquarters: Atlas Copco AB, Stockholm 1, Sweden.

### *Atlas Copco*

puts compressed air to work for the world

THE MINING MAGAZINE

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**The *best* form  
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**FRASER & CHALMERS ENGINEERING WORKS, ERITH, KENT**



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## How long does a Ferodo lining last?

On these winding-engine hoists in two well-known Rand goldmines, Ferodo Friction Linings continue to give absolutely safe and accurate control after 20 and 15 years service respectively.

The fact that the second hoist is not equipped with dynamic braking makes this achievement all the more remarkable.

Consistently, dependably, and without fire risk, Ferodo Friction Linings provide safe braking and power transmission in every part of a mine. That's why so many mining engineers specify Ferodo for longer working life and complete safety in all mining operations.

### DETAILS OF HOISTS SHOWN:

Hoist No. 1 Hoist No. 2  
(no dynamic braking)

	H.P. 900	1950
Depth of shaft	2850 ft.	3500 ft.
Tonnage pulled per 8 hour shift	1200	600
Trips per shift (men)	—	50
Trips per shift (rock)	175	130
Brake applications per shift	350 appr.	390 appr.

## FERODO FRICTION LININGS FOR INDUSTRY

Ferodo supplies and service available throughout the world

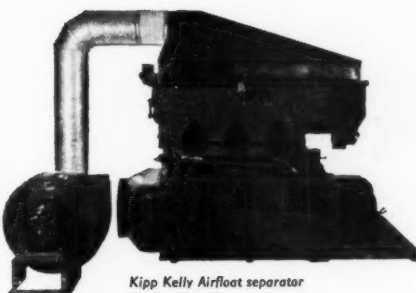
FERODO LIMITED · CHAPEL-EN-LE-FRITH · DERBYSHIRE · ENGLAND *A Member of the Turner & Newall Organisation*

EXK110

# KIPP KELLY AIR-FLOAT SEPARATOR

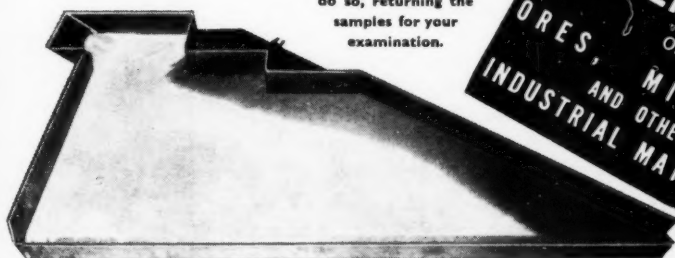
Dry concentration has many advantages over wet methods except when water is actually required as a solvent or when wet working is needed prior to producing a separation. Consider these advantages :

- Produces higher grade product with less loss than is possible by wet concentration.
- Dry concentration plants may be located anywhere, regardless of water supply. No water to pump or bring from a distance, thereby eliminating that cost.
- Increased capacity cuts down number of units and space necessary, resulting in smaller and less expensive plants with low power costs.
- Due to the greater sensitivity to slight differences in density of the particles, Dry Concentration will successfully treat ores which are not amenable to wet concentration.
- Ore may be efficiently separated at the economical releasing point of the minerals.

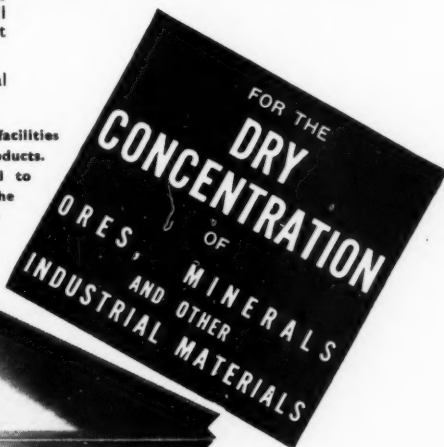


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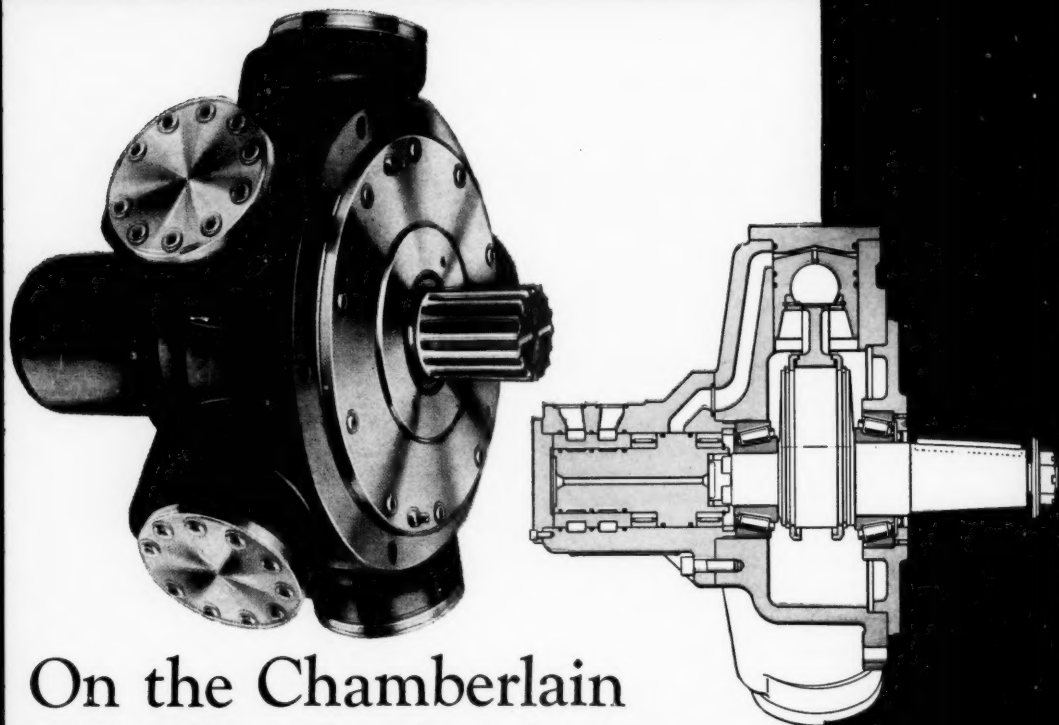
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Telephone : Mincing Lane 6652

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## On the Chamberlain 'STAFFA' hydraulic motor

These hydraulic radial motors, made by Chamberlain Industries Limited, of London, are made in two models, intended for use with applications ranging from coal conveyors to plastic extrusion presses, where their flexibility is invaluable. The motors normally operate at 2,000 p.s.i., but are capable of operating at 3,000 p.s.i. for starting and peak loads.

Full torque is developed at speeds from 1 to 100 r.p.m.; the Mark IV five-cylinder model has a maximum output torque of 4,750 lb. ft. and the Mark V seven-cylinder model 6,650 lb. ft., both at 2,000 p.s.i.

The rotary valve, developed by the makers, is driven from the main shaft through an Oldham coupling and is carried in needle-roller bearings.

The connecting rods—looking much shorter than their functional length—are ball-jointed into the piston and have 'slipper' big-end bearings riding upon the eccentric main shaft; this runs in Timken tapered roller bearings.

British Timken, Duston, Northampton, Division of The Timken Roller Bearing Company. Timken bearings manufactured in England, Australia, Brazil, Canada, France and U.S.A.

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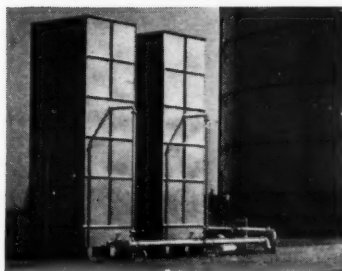
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Weight of rig: 600 lbs, in seven  
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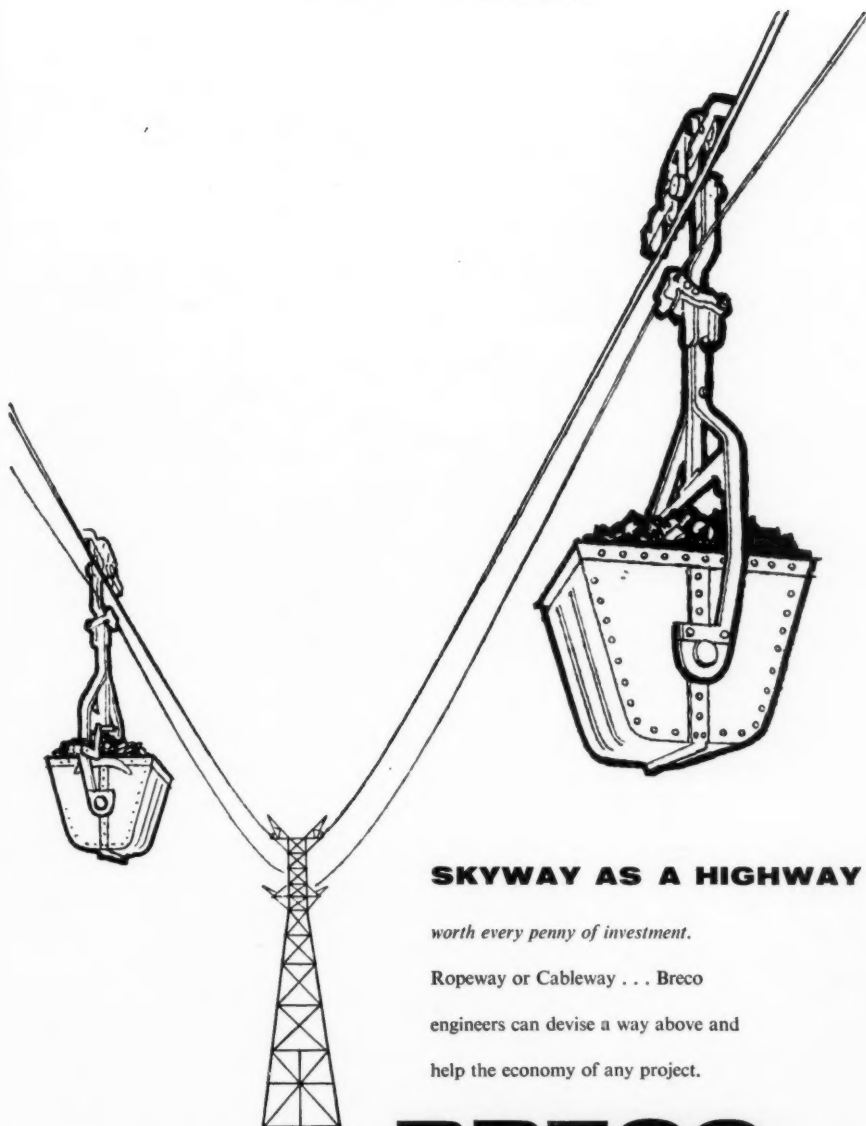
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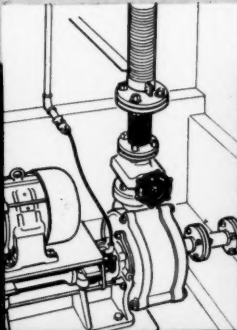


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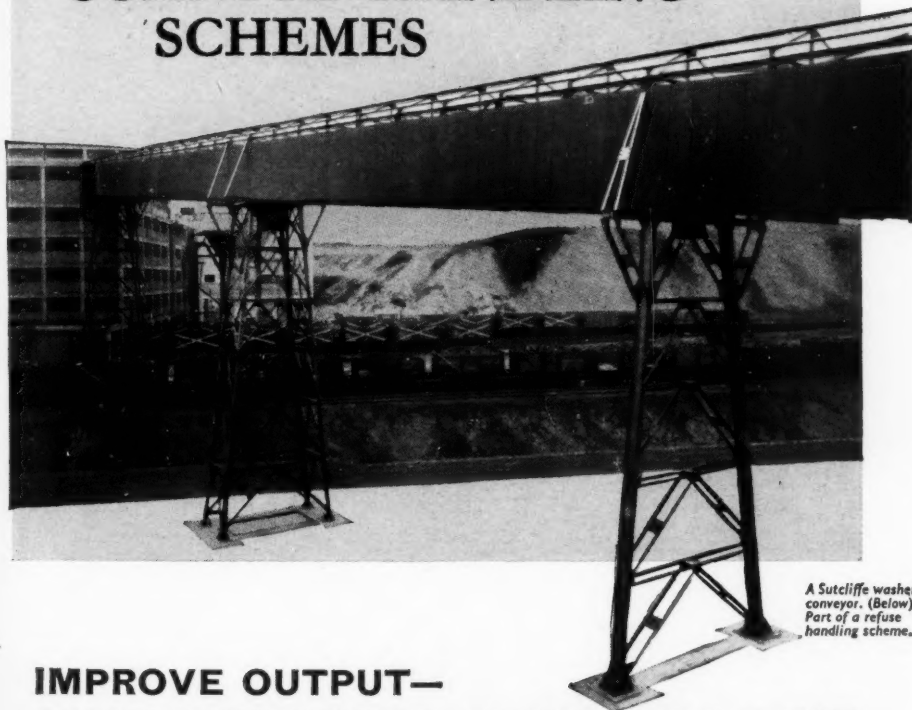
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## SURFACE HANDLING SCHEMES

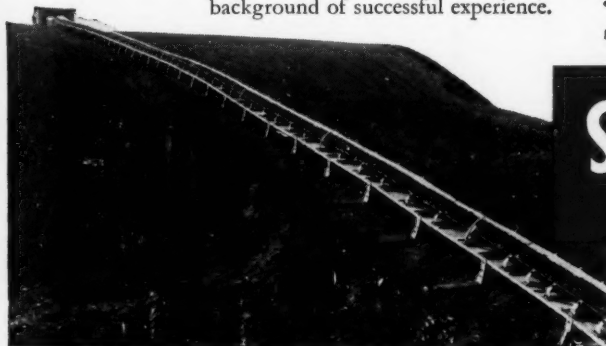


A Sutcliffe washery conveyor. (Below)  
Part of a refuse handling scheme.

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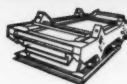
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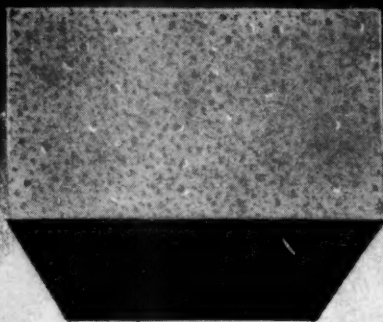
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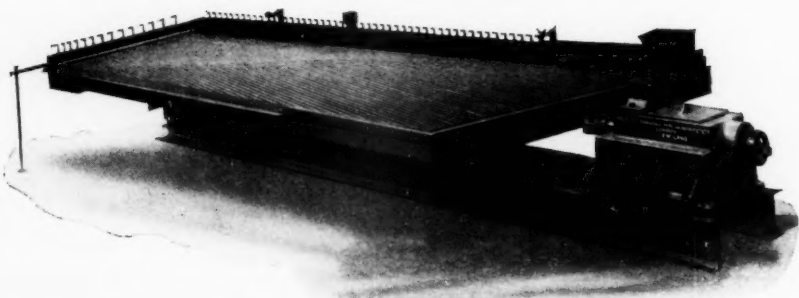
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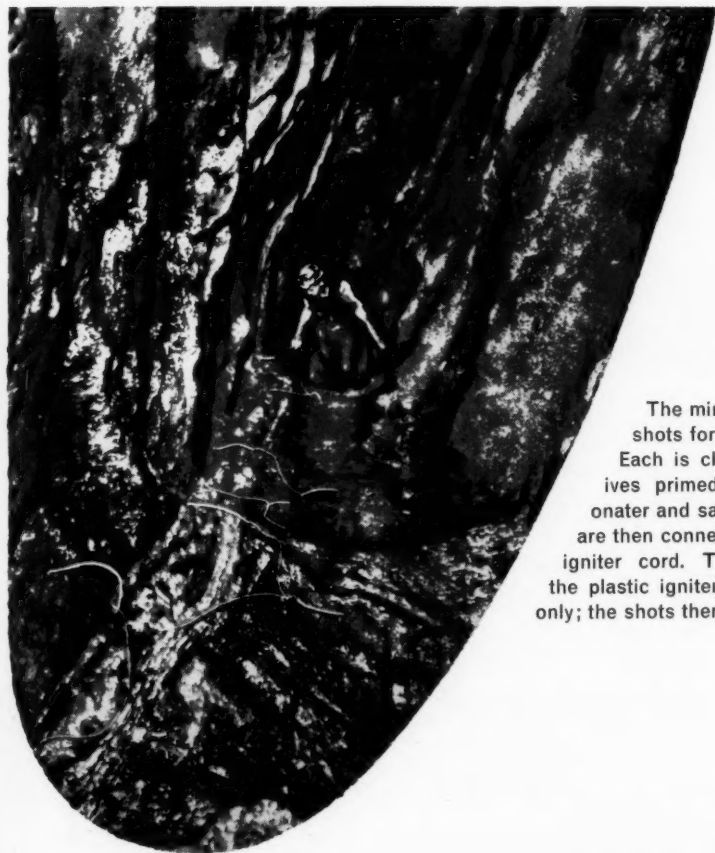
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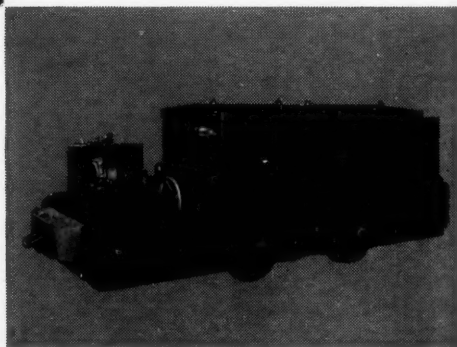
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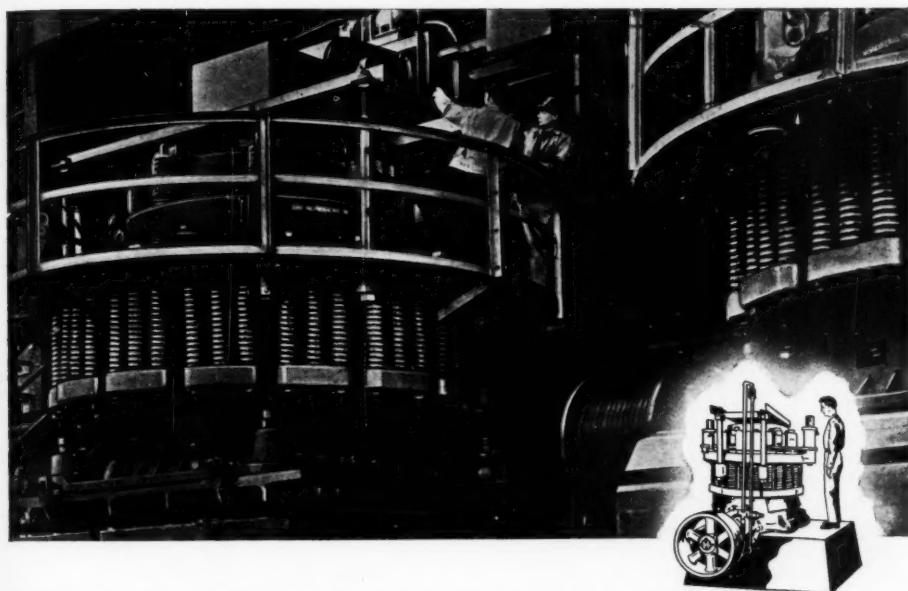
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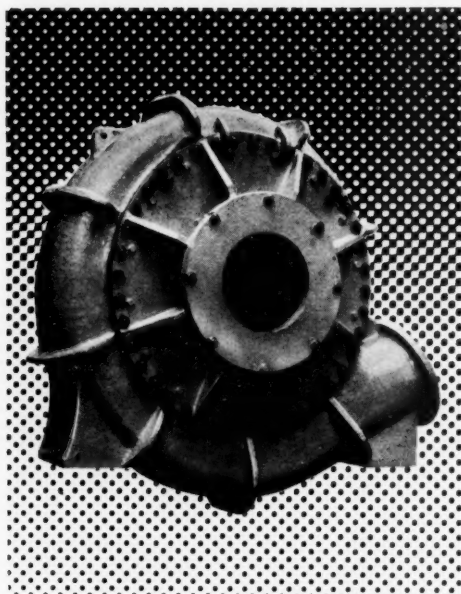
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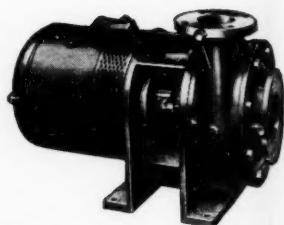
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## SINK-AND-FLOAT ore concentration plants

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**Mining Costs** by providing cheap stope fill

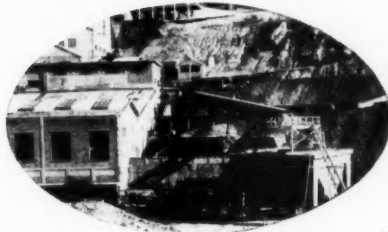
**Milling Costs** by eliminating hard sub-economic mined rock

### INCREASE

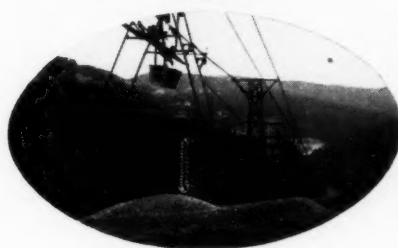
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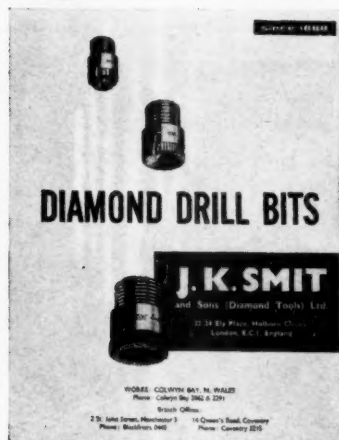
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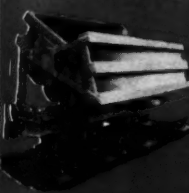







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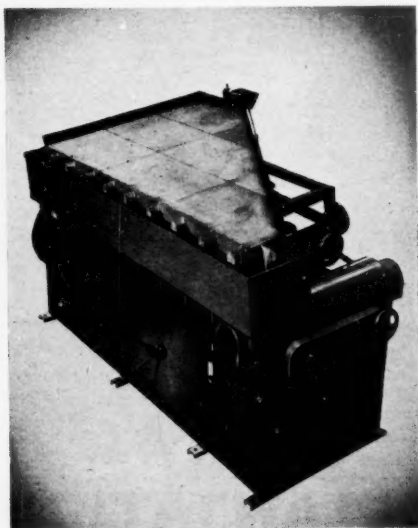
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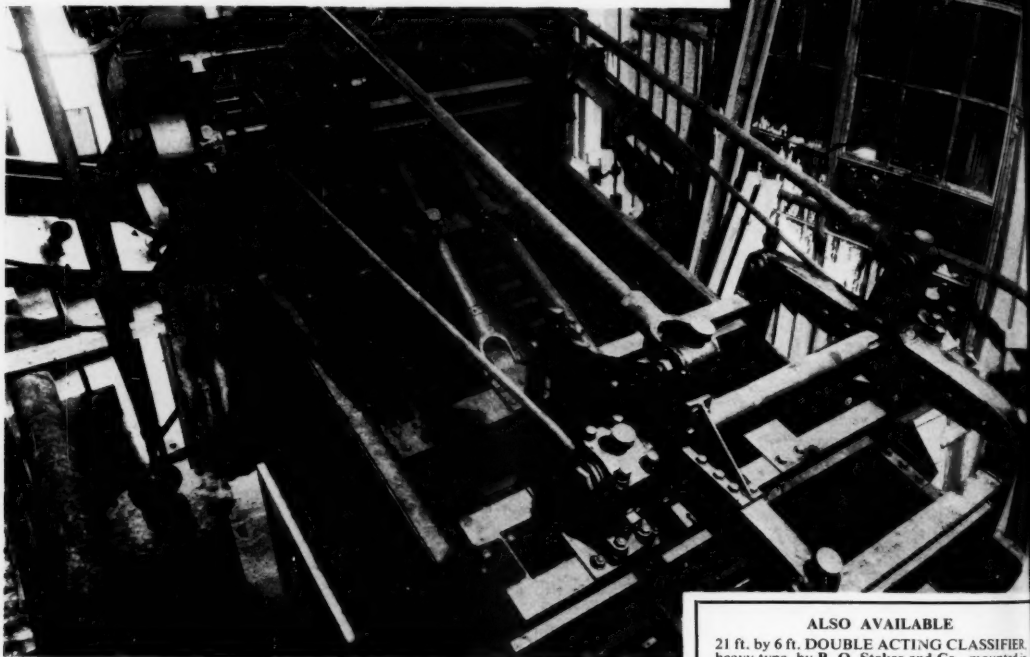
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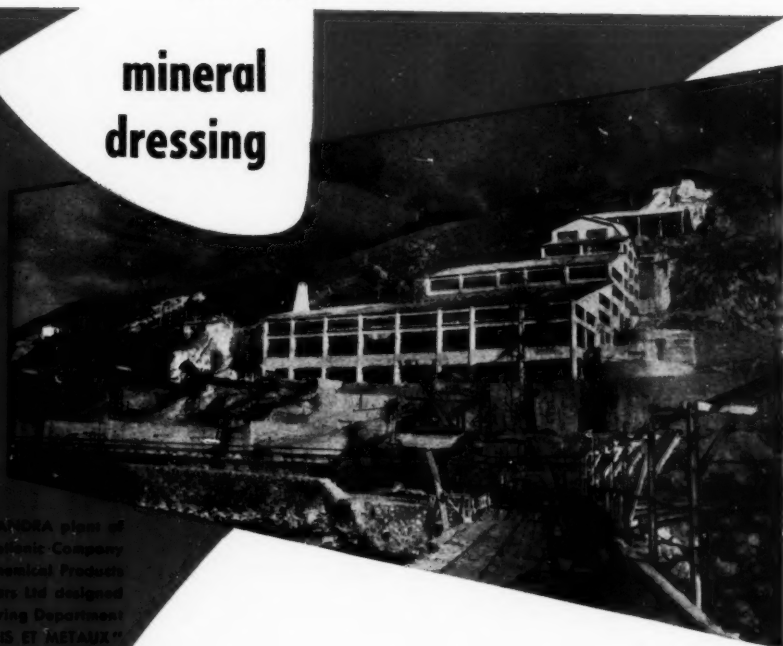
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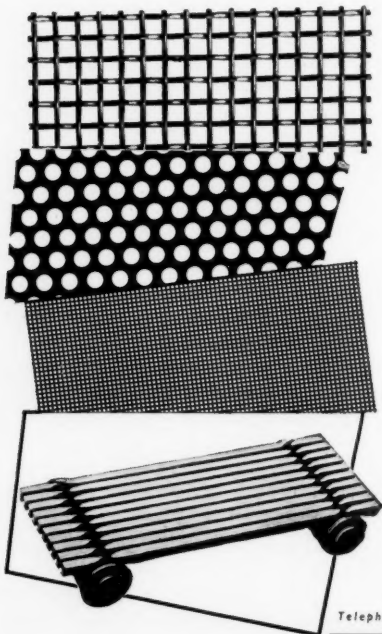
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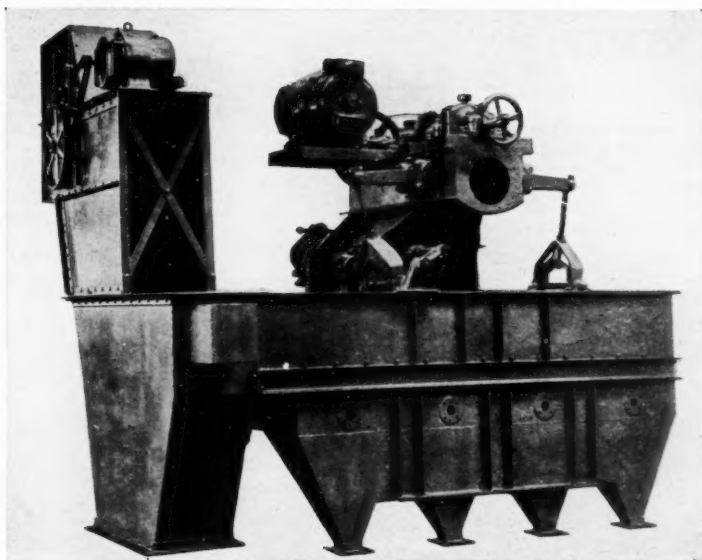
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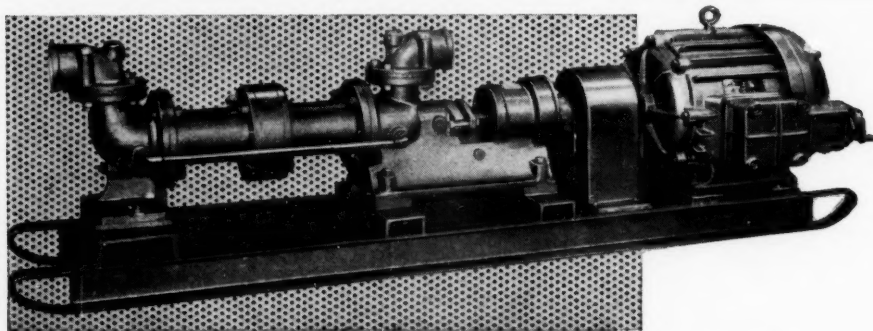
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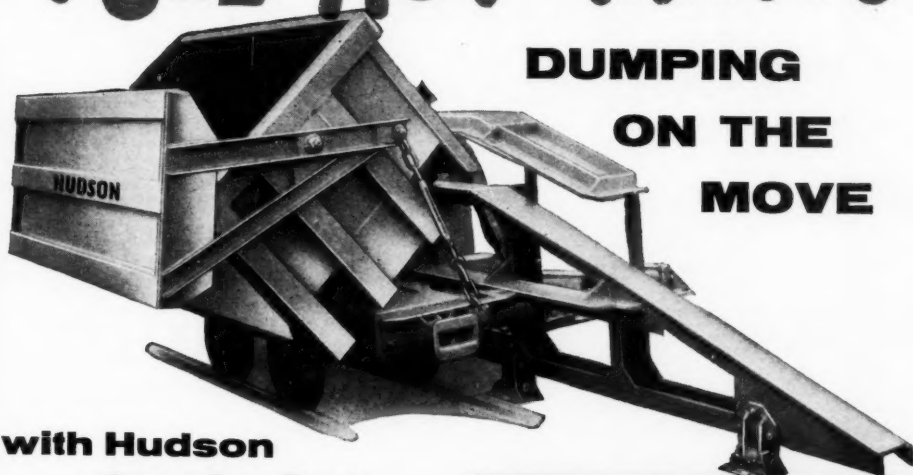
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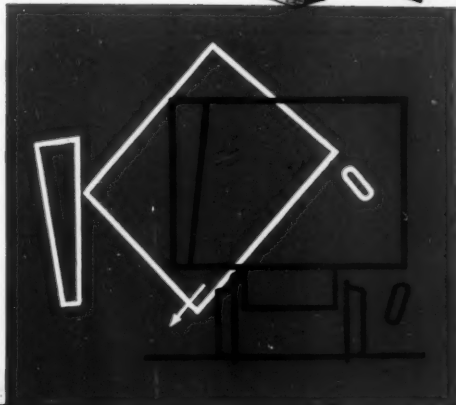
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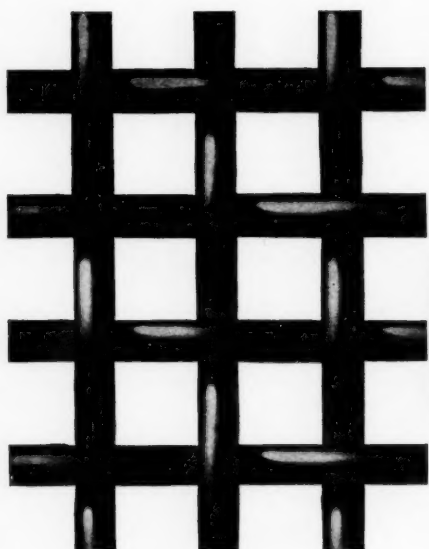
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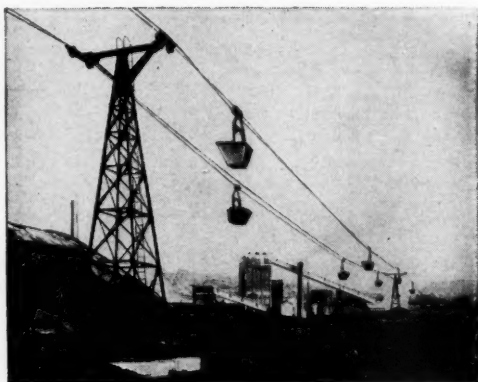
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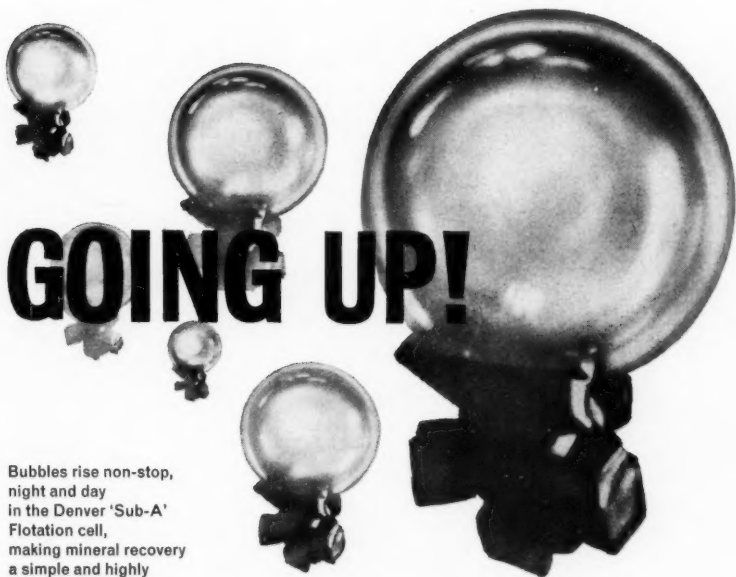
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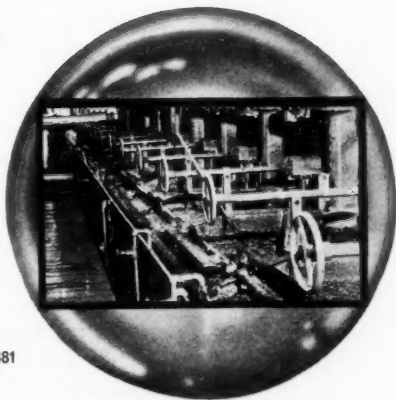


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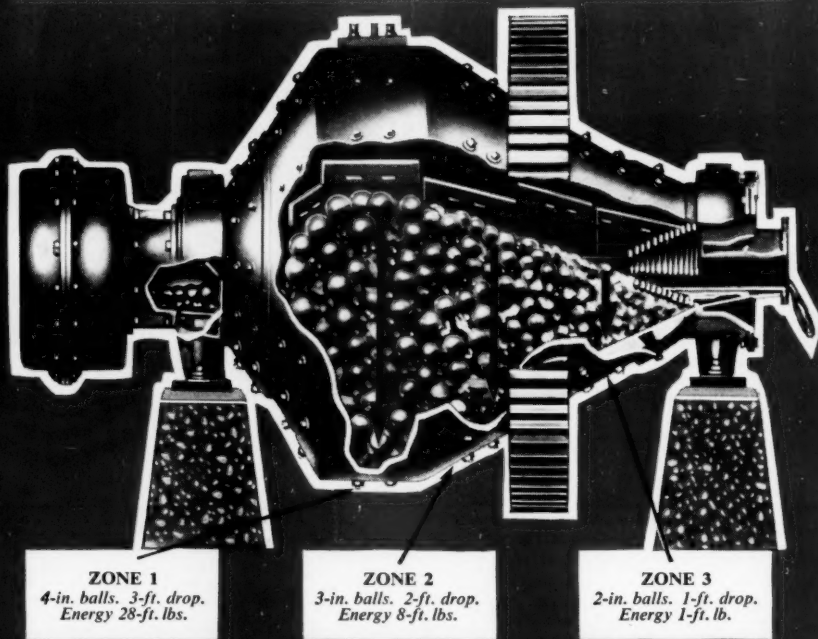
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## EDITORIAL

THE Council of the Institution of Mining and Metallurgy has invited applications for awards from the income of the G. Vernon Hobson Bequest "for the advancement of the teaching and the practice of geology as applied to mining." One or more awards may be made for travel, research, or other objects and application should be made to the Secretary before January 31 next.

CONTINUED interest in the training of mining engineers is evident in the report of the British Overseas Mining Association for the year to September 30 last. There it is noted that the value of the scholarships awarded by the B.O.M.A. Educational Trust has been increased from £300 to £350 per annum and that in the year under review 39 applications were received for scholarships. Of these, 13 were awarded, subject to definite acceptance of the candidates by one of the recognized schools of mines and universities for courses in mining engineering, and 10 have begun their courses. This brings the total of B.O.M.A. scholars now in residence at schools of mines and universities in their first, second, and third years up to 22.

FOR the first time since 1941 the exports of gold from Tanganyika exceeded £1,000,000 in 1959, according to the annual report of the Department of Mines. Exports of silver were also higher than in previous years. The improvement was brought about largely by the Kiabakari mine of the Tangold Mining Company, which came into production in February, 1959, although significant improvements in output were recorded from the Geita mine and also from both alluvial and reef small-workers. The report says that the year was one of continued steady progress for the mining industry and for the first time the value of mineral production exceeded £7,000,000. The principal events were the coming into production of two major undertakings, the Kiabakari gold mine in Musoma District already mentioned and Kaborishoke tin mine in the Karagwe District, as well as the proving of substantial tonnages of phosphate in the Mbulu district. The record was marred somewhat, it is stated, by the announcement that Mpanda lead mine would close down

during 1960 on the exhaustion of its ore reserves. Mineral exploration continued in many parts of the Territory but particularly in the 34,000 sq. mile area held under licence by the Western Rift Exploration Co., Ltd., in the Western and Southern Highlands Provinces, but a disappointing feature was the withdrawal of Consolidated Gold Fields of South Africa, Ltd., from their operations in the Karagwe tinfield. The Territory's diamond production, valued at £4,500,000, exceeded that for the previous year, but the value of lead-copper concentrates was slightly less than that achieved in 1958. In addition to this significant amounts of salt, mica, tin concentrates, and gypsum and lesser quantities of coal, garnet, graphite, kaolin, lime, magnesite, meerschaum, and vermiculite were produced.

IN a recent paper published by the Metallurgical Society of A.I.M.E., Mr. C. R. Kuzell, of the Phelps Dodge Corporation, suggested that to-day, after thousands of years, the copper-smelting plant has developed into an extremely simple two-step process. The first step, the smelting of "wet" concentrate with recycled molten converter slag in a reverberatory furnace for the production of molten matte, was followed by the second, the conversion of the molten matte to blister copper. The smelting plant, he said, is no longer a reduction works—that is, in the chemical meaning of the word "reduction." It merely selectively oxidizes the iron and the sulphur to free the copper. It was the phenomenal demand of the 20th Century and the achievements of the mineral engineers that put the pressure on the modern metallurgists to come up finally with the simplest of all—"simple smelting and selective oxidation." As to current practice the author pointed out that some plants are using preheated air in the firing of reverberatory furnaces. Thought was being given to preheating of such combustion air to even higher temperature by utilizing the exhaust of the modern gas turbine and, if that becomes successful, power would be produced from both ends of the reverberatory furnace. Many metallurgists were contemplating how they could use oxygen in converting of matte and at the same time control the heat and put it to profitable use.

**M**INERAL production in Australia continued to advance in 1959, new records being reached, for example, in the mine, smelter, and refinery production of copper. The most recent issue of the "Australian Mineral Industry Quarterly Review," published by the Bureau of Mineral Resources, shows that the mine production of copper for 1959 was 94,404 tons, an increase of 19,386 tons over the 1958 figure of 75,018 tons. Blister output was increased to 68,475 tons and primary refined metal to 51,415 tons principally from Mount Isa mine, where the first phase of the long-term expansion programme was completed. The Acting Minister for National Development says that although Australian producers of some mineral products were still faced with marketing difficulties during 1959 activity in the industry generally continued at a high level. From preliminary information it is expected that the total value of output for the year (excluding uranium oxide) was slightly above the 1958 level of £202,000,000. Lead and zinc production in 1959 was somewhat lower than in previous years and the output of tungsten concentrates was at its lowest level for many years, while rutile production was also well below production capacity. On the other hand, the production of iron ore increased in 1959 by 224,769 tons and that of asbestos, zircon, and brown coal also showed worthwhile gains. The total value of mineral exports (excluding gold) rose from £49,800,000 in 1958 to £54,000,000 in 1959. Mineral imports (excluding gold) totalled £89,000,000, as compared with £88,400,000 in the previous year. These figures include imports of crude oil which were valued at £71,000,000 in 1959.

### **New Sinter Plant at Workington**

At the plant of the Workington Iron and Steel Company sintering was originally adopted in 1943, the plant being expanded subsequently to produce about 6,000 tons of sinter per week. This plant, it is claimed, has successfully shown the advantages of the use of sinter in blast-furnace work, but it was decided that it would be uneconomic to modify it in order to produce the additional quantities of improved quality now needed at Workington. Accordingly the decision was taken to build the new plant and this, costing £2,500,000, was officially opened on December 6 by Crown Prince Harald of Norway.

Of single-strand continuous design the plant will ultimately produce 12,500 tons of self-fluxing sinter per week. Now in operation with the code name, FOCUS, which stands for "Foreign Ore Concentrates Usage," it is being brought up gradually to its rated capacity. Early indications are that the beneficial effects anticipated on blast-furnace operations will be more than fully realized, a reduction in coke consumption having already been made possible following the use of the sinter.

The United Steel Companies have emphasized that post-war developments in Norway have made available considerable tonnages of iron ore particularly well suited to the acid Bessemer process employed at Workington. The ore is mined in open-cast workings by the Sydvaranger Company at Kirkenes, in the far north of Norway. After processing the ore is shipped in the form of a concentrate containing 65% iron and low in phosphorus and other impurities. It is intended to consume between 60% and 70% of these Norwegian concentrates in the raw materials supplied to the new sinter plant, equivalent to an annual intake of 400,000 tons. The balance will be provided from other overseas sources and from the company's own hematite ore mines in Cumberland, currently producing about 120,000 tons a year.

The bulk of the company's ore requirements arrive by sea at the nearby Workington harbour, which can accommodate vessels of up to 10,000 tons and is equipped for the rapid discharge of ore and the loading of finished steel products. Imported ore is conveyed by rail wagons to the material storage building, in the stock bays of which there is capacity for 44,000 tons of fines. The building is divided into five separate bays with the following capacities: Sydvaranger concentrates, 16,500 tons; hard-ore fines, 11,500 tons; soft-ore fines, 9,000 tons; home-ore fines, 7,000 tons, and coke breeze, 350 tons. Sinter mixture is fed on to a gathering belt by 9 ft. diameter rotary feeder tables fitted with speed adjustment, the coke feeders having independent speed control. After primary mixing in a twin-paddle rotary-drum mixer of 200 tons per hour capacity the mix is conveyed onwards to a surge hopper from which it is fed under control to a pelletizing drum whence it goes to the sinter strand. Discharged sinter oversize is fed to a Lurgi-Frodingham circular cooler with a designed capacity of 100 tons per hour, the hot undersize sinter being carried to a

quenching station for separation and smalls finding their way back to the sinter strand. By this means the only company which to-day is producing steel by the acid Bessemer process will have made sure of its capacity to continue its important supply of permanent-ware materials.

### Western Australian History and Progress

With the report for the year to June 30 last shareholders of Lake View and Star, Ltd., have received an illustrated brochure covering "Fifty Historical Years," the story of the company's development over the past half-century. To most people the "Lake View" may be just another gold-mining company, but, the largest producer of that much-needed commodity in Australia, its progress, particularly over recent years, has been outstanding. Everything about it is big, with leases covering 1,159 acres and mines that have been at work for 67 years. In its life it has produced over 5,500,000 oz. of gold and although over 20,000,000 tons of ore have been milled the ore reserve is even now over 3,500,000 tons, with an attractive future ahead.

Western Australia, of course, has other resources than gold. The current season has been very good for agricultural workers and in keeping with the marked tempo of industrial and population growth high grain yields are anticipated. To supply the super-phosphate required there are large works near Fremantle and Perth, using imported sulphur and a proportion of mined pyrite supplied from Norseman and the Golden Mile. There are works of smaller but important capacity near Bunbury, Albany, and Geraldton, the output exceeding 600,000 tons per annum. Plans are prepared for extensions of up to 100,000 tons. The rapid growth of what are called "South Coast Areas"—Esperance—indicates that shortly at that port there will have to be a super-phosphate project, which could indicate a marked reduction in rail costs for Norseman pyrite as well as a possibility of the use of Phillips River (copper) concentrates and for both centres a direct outlet for their sulphur potential. Strange as it may seem or sound 1960 is the sixth consecutive year in which the price of "super" has been lowered due to increase in capacity, mechanization, and closer control. Works at Esperance could mean a very great boost to Norseman pyrite

(present output valued at about £A23,000 per month) and have considerable interest to the Phillips River copper-gold interests as well as to the Golden Mile pyrite sales.

The iron-ore industry in the State is also progressing. For some time past in these columns and elsewhere mention has been made of the efforts of the State Government to persuade the Commonwealth authorities to permit export at least of some of the ore as a means of building up State finances and thus permitting certain development programmes. So far the Commonwealth has been adamant. Almost "out of the blue" now comes the startling information that an agreement is to be reached between Broken Hill Proprietary and the State Government for the setting up of blast-furnaces for a complete steel industry at Kwinana, contingent upon the almost immediate construction of a standard-gauge rail link with Kalgoorlie, the economics of transport of ore from Koolyanobbin demanding this. B.H.P. already have rolling mills and an area available in close proximity to Kwinana, which is the site of a large B.P. oil refinery now being followed with very extensive additions. The iron-ore deposits at Koolyanobbin (30 miles north of Southern Cross) are extensive and exceed 100,000,000 tons on present figures, with much more to come it is believed. The ore (61.9% Fe) has been in steady use for the charcoal-iron project at Wundowie. With Geraldton as a port there are large deposits of ore available as well at Mount Goldsworthy with a port at Port Hedland.

In this brief review of progress in Western Australia mention should also be made of the beach-sand industry now thriving in the lower south-west of the State—the Bunbury region. In common with all other similar projects lowering of prices and/or restriction of demand in the last two years has had a steadying effect. Careful laboratory work has, however, been done by three operating companies with a consistent high-grade product from the well-designed and operated mills. Considerable tonnages of both ilmenite and zircon have been shipped at intervals to various industrial centres. Some time ago there were some proposals for the establishment of a titanium oxide industry at Bunbury but for various reasons the project was dropped. Recently, however, the whole proposal has been opened again and it is thought that better times for the beach-sand industry are approaching.

## MONTHLY REVIEW

**Introduction.**—The Government still maintains its pressure on the economy, in evident determination to direct labour away from the over-stocked consumer-goods industries and it seems plain that employment is being maintained at a high level even if some concerns are feeling the pinch. In the meantime commodity prices continue firm at current levels.

**Transvaal.**—The output of the Rand and O.F.S. gold mines for October totalled 1,777,495 oz., making with 35,967 oz. from outside producers a total of 1,813,462 oz. for the month. At the end of October there were 368,391 natives at work in the gold mines, as compared with 369,751 at the end of the previous month.

The operations of BUFFELSFONTEIN GOLD MINING in the year to June 30 last resulted in a profit of £5,752,450, of the £5,876,713 available £1,993,750 being required for dividends equal to 3s. 9d. a share. In the year 1,726,000 tons of ore was milled and 671,607 oz. of gold and 768,476 lb. of uranium oxide recovered. Ore reserves at the end of the year are given as 4,275,000 tons averaging 9.27 cwt. in gold and 0.726 lb. of uranium oxide per ton over 58.6 in.

At the annual meeting of HARTEBEEST-FONTEIN GOLD MINING the chairman referred to the record footage sunk at No. 4 shaft in October, an achievement described elsewhere in this issue. He went on to say that while progress had not been so easy in November the high sinking rate should materially advance the date when a holing on the 29th level can be effected and additional ventilation facilities provided to meet the expansion of operations in the deeper area of the mine. The fast sinking rate, he said, could be largely attributed to effective pre-cementation and to the use of new hydraulic lashing equipment with a 30 cu. ft. capacity grab and bigger kibbles.

Earlier this month the directors of LESLIE GOLD MINES announced that the Reef had been intersected at No. 1 shaft at a depth of 1,487 ft. below the collar and that sampling round the whole perimeter gave 16.5 dwt. over 13.6 in., equivalent to 224 in./dwt.

The accounts of SOUTH AFRICAN TORBANITE MINING AND REFINING for the year to June 30 last show a profit of £250,378 and £308,548 available, of which a dividend

equal to 15% requires £104,016. In his review accompanying the report and accounts the chairman said that the production of torbanite crude oil at Ermelo, assisted by the continued extraction of torbanite remnants from the higher-grade areas mined previously, amounted to a total of 6,165,333 gal. from 162,368 tons of torbanite at a yield of 38 gal. per ton. However, he said, all payable torbanite deposits at the Ermelo mine had now been extracted and production there ceased at the end of September, 1960.

In the year ended June 30 last ROOIBERG MINERALS treated 167,569 tons of ore and produced concentrates containing 677 long tons of tin. The accounts show a profit of £85,571, of which dividends equal to 3s. 6d. a share require £35,000.

The accounts of the ANGLO-TRANSVAAL CONSOLIDATED INVESTMENT COMPANY for the year to June 30 last show a profit of £1,032,313 and an available total of £1,424,712. Dividends require £654,617, equal to 60% on the ordinary and "A" shares.

**Orange Free State.**—As has been noted already by our South African correspondent, milling operations at FREE STATE SAAIPLAAS started in October, the intersection of water-bearing fissures requiring cementation in the mine having retarded development. It is intended to extend the plant capacity to 100,000 tons monthly as soon as the ore-reserve position warrants it.

EASTERN RAND EXTENSIONS announced last month that Borehole VK.4, drilled in conjunction with the GENERAL MINING AND FINANCE CORPORATION and LYDENBURG PLATINUM on the farm Vermeulenskraal Noord No. 480, District Ventersburg, entered foot-wall quartzites at a depth of 7,536 ft., the Basal reef being absent. The "B" reef was intersected at 7,518 ft., assaying 10.1 dwt. over a corrected width of 74.1 in. In view of the disappointing results obtained from the Basal Reef horizon in the eight boreholes drilled on and adjacent to this farm and the adjoining farm Video No. 305 no further drilling is contemplated.

PRESIDENT BRAND GOLD MINING has announced that borehole S.P. 7 on the Farm Stuurmanspan, situated 6,900 ft. due south of No. 2 Sub-Vertical Shaft, intersected the Basal reef at a depth of 5,849 ft., assaying 3.03 dwt. of gold per ton, over a width of

13.5 in. A hanging-wall leader intersected at 5,846 ft. assayed 7.7 dwt. over 8.5 in. A deflection is being made.

Earlier this month the directors of PRESIDENT STEYN GOLD MINING announced that a further deflection had been made to bore-hole Klippan No. 11, situated approximately 8,500 ft. south of No. 2 shaft. In this the Basal reef was intersected at 6,701 ft. and assayed 153.3 dwt. of gold a ton over a corrected width of 9.85 in. In the original intersection a value of 629 in.-dwt. was obtained.

**South-West Africa.**—In the year to June 30 last the SOUTH WEST AFRICA COMPANY produced 8,502 tons of lead vanadates, 198 tons of zinc concentrates, 199 tons of tin-wolfram concentrates, and 6,065 tons of salt, operations resulting in a loss of £4,609. The chairman says that the company's exploration activities are now being concentrated mainly upon detailed mapping to define geological structures favourable to mineral deposition and, where results are encouraging, geophysical surveys are to be run preparatory to possible further diamond drilling.

**Southern Rhodesia.**—The accounts of the CORONATION SYNDICATE and its subsidiaries for the year to June 30 last show a profit of £192,771 and £211,186 available, of which dividends equal to 7d. a share require £93,917. At the Muriel mine 55,064 tons of ore treated yielded 21,838 oz. of gold, while at the Arcturus property 90,644 tons milled yielded 28,178 oz.

The WANKIE COLLIERY COMPANY reports a profit of £1,084,060 for the year to August 31 last, the accounts showing £1,423,336 available, of which dividends totalling 1s. 3d. a share require £659,726. In the year 3,849,618 tons of coal and 188,771 tons of coke were produced, in addition to tar, ammonia, benzol, and 37,360 tons of bricks and refractories.

**Northern Rhodesia.**—The report of the RHOKANA CORPORATION for the year to June 30 last shows a profit of £11,534,278 and £8,750,007 distributed as dividends, equal to 7s. a unit of stock. The mill treated 5,291,500 tons of ore and produced 103,981 tons of copper, 76,861 tons being electrolytic. Reserves are given as 120,347,000 tons averaging 3.07% copper.

From a profit of £3,693,000 for the year to June 30 last BANCROFT MINES paid £1,381,250 in dividends, equal to 1s. 7.2d. per unit. In

the year 1,655,700 tons of ore was milled and 51,121 long tons of blister copper produced.

RHODESIAN ANGLO AMERICAN reports a profit of £7,134,552 for the year to June 30 last, £5,263,386 of the £7,512,117 available being required for dividends equal to 8s. a unit of stock.

At the end of the financial year on June 30 last the ore reserves of the mining companies in the RHODESIAN SELECTION TRUST GROUP totalled 430,151,000 tons. To this amount MUFULIRA contributes 178,769,000 tons, ROAN ANTELOPE, 94,592,000 tons, CHIBULUMA, 9,790,000 tons, BALUBA, 112,000,000 tons, and CHAMBISHI, 35,000,000 tons. The two last-named properties are as yet undeveloped. In the first quarter of the current year Roan Antelope produced 22,019 long tons of copper for an estimated profit of £1,507,000, Mufulira, 27,838 tons for a profit of £2,244,000, and Chibuluma, 5,121 tons for £345,000.

**Sierra Leone.**—According to reports from Sierra Leone prospecting for bauxite in that country has been progressing with encouraging results, a special exclusive prospecting licence for bauxite being recently granted by the Government to a Swiss company, ALUMINIUM-INDUSTRIE-ZURICH. A Government geologist has been doing drilling and pitting and prospecting over an area of six miles in the Mokanji Hill has so far proved encouraging.

**Tanganyika Territory.**—Shareholders of TANGANYIKA DIAMOND AND GOLD DEVELOPMENT have been informed that in the three months to September 30 last, ALAMASI, LTD., treated 125,477 loads of ground and recovered 6,787 carats of diamond.

**Australia.**—Elsewhere in this issue our Metal Markets correspondent refers to the agreement between the CONSOLIDATED ZINC CORPORATION and the KAISER ALUMINUM AND CHEMICAL CORPORATION in respect of the development of the Weipa bauxite deposits in northern Australia. The Kaiser interests have suggested that the partnership with Consolidated Zinc will create a major new source of aluminium from resources which will provide many economic advantages and production operations ideally situated to serve world markets, particularly those rapidly developing in the Pacific area. It is thought that consumption will more than double in the area by 1970, while the installation of new industrial facilities and the development of bauxite and hydro resources will make a substantial contribution to the

economic growth of Australia and New Zealand.

In the report of Mount Isa Mines for the year to June 30 shareholders are informed that outside the Mount Isa area prospecting and exploratory work continued on the McArthur River Authority to Prospect, located in the Northern Territory some 400 miles north-west of Mount Isa; the Blue Range Authority to Prospect, located in the Blue Range district approximately 120 miles north-west of Townsville; the Many Peaks area, in which are located the Glassford Creek, Mount Cannindah, and Mount Kroombit copper prospects, and the Chillagoe Authority to Prospect, in which is located the Ruddygore copper prospect. Within the above Authorities to Prospect interesting areas are being examined, it is stated, and it is planned to intensify outside property examination during the ensuing year.

With the recent dividend notice shareholders of LAKE VIEW AND STAR are informed that the profit from mining operations for the year ended June 30 last was £400,032, subject to audit. After deducting £54,576 for depreciation, £214,375 for dividends, setting aside £129,000 for taxation, and bringing in £75,905 from the previous year there is a balance of £77,986 to be carried forward. Speaking at the annual meeting earlier this month the chairman commented on the fact that the adoption of electric hoisting at the mine had resulted in a reduction in costs amounting to 2s. 3d. per ton milled. However, in an attempt to reduce costs and improve efficiencies two other changes have now been introduced. The first involves the increased use of electric power for secondary ventilation which, in the past, has been largely dependent on compressed air-driven units, while the second is the introduction of hydraulic fill derived from mill tailings for filling of selected cut-and-fill stopes, instead of gravel-fill derived from surface pits and dumps. The main advantage of this plan is that the hydraulic fill, it is stated, can be delivered direct to the stopes by pipe, while the gravel-fill frequently has to be trucked into the stopes, involving several stages of handling. Both schemes are said to be proceeding satisfactorily.

**New Guinea.**—In the three months to August 31 last BELOLO GOLD DREDGING treated 1,440,207 cu. yd. of ground and recovered 4,918 oz. of gold.

**Malaya.**—In his address prepared for shareholders of MALAYAN TIN DREDGING and

SOUTHERN MALAYAN TIN DREDGING attending the annual meeting called for December 16 the chairman refers to the future of the Kampong Gajah property on which the future of Malayan Tin Dredging depends. He says that as a result of further boring of the undredged ground and experience in the operation of dredges on the property there has been a small increase in the estimated average dredging depth of the ground. The latest estimate is that at June 30, 1960, the reserves amounted in round figures to 370,000,000 cu. yd. of ground. The estimated life of the property of at least 35 years with three dredges in continuous operation is still valid. It is the company's intention to equip this area with four large dredges but plans have been delayed by the incidence of Export Control. The installation of the intended fourth dredge is now under consideration, but, since the Control Scheme is likely to remain in force for a number of years, it will be necessary before proceeding to be assured that if Export Control is imposed again the company will, in the event of its installing a fourth dredge on the property, obtain an assessment covering its estimated production.

PAHANG CONSOLIDATED produced 2,252½ tons of tin concentrates in the year to July 31 last and made a profit of £167,043. The accounts show £273,067 available, of which dividends require £114,537, equal to 18% on the ordinary shares. In his address to shareholders accompanying the report and accounts the chairman reminds them that Mining Lease No. 1 of 1899 under which the Concession is held expires in 1968. Negotiations with Government as to terms of renewal have been in progress for some time, but at the present stage negotiations are not concluded.

**United States.**—At an extraordinary meeting of the MOUNTAIN COPPER COMPANY held on November 25, the resolution that the authorized capital be increased from £750,000 to £900,000 by the creation of 500,000 new shares of 6s. each was unanimously passed.

At the mine of the HUMBOLDT MINING COMPANY in Michigan a 650,000 ton a year plant for the production of high-grade iron-ore pellets from low-grade "jasper" rock was opened on September 16. Open-pit operations began at the Humboldt mine in 1954 when the original concentrator was built. It had a capacity of 325,000 tons of concentrate per year. Now, with capacity

doubled, the mine is able to produce the concentrate in pellet form.

**Canada.**—It was announced last month that the INTERNATIONAL NICKEL CO. OF CANADA is to proceed immediately with the expansion of its iron-ore recovery plant at Copper Cliff, tripling its capacity. Diversion of large quantities of pyrrhotite to the expanded iron plant will effect a 40% decrease in the tonnage of material which otherwise would have to be handled by the nickel section of the Copper Cliff smelter. The iron-ore recovery plant capacity for the output of iron-ore pellets containing 68% iron will be raised to 900,000 short tons per year and more nickel will be recovered from the same amount of pyrrhotite. The expanded plant is scheduled to be in full operation in 1963 and will entail a total estimated capital outlay of \$50,000,000, of which up to \$10,000,000 is scheduled for 1961.

### DIVIDENDS DECLARED

\* Interim. † Final.  
(Less Tax unless otherwise stated.)

- †Anglo-Huronian.—25 cents, payable Jan. 25.
- †Ayer Hitam Tin Dredging.—4½d., payable Jan. 25.
- †Consolidated African Selection Trust.—2s. 9d., payable Dec. 30.
- Consolidated Co., Bultfontein Mine.—Half-yearly, 7d., payable Jan. 28.
- \*Consolidated Zinc Corporation.—Pref. 2½d., Ord. 1s. 3d., payable Jan. 2.
- Griqualand West Diamond Mining Co.—Half-yearly 2s. 10d., payable Jan. 28.
- \*Henderson's Transvaal Estates.—4d., payable Jan. 6.
- †Ipoh Tin Dredging.—3s., payable Dec. 21.
- †Kepong Tin Dredging.—3d., payable Jan. 27.
- †London and African Mining Trust.—3d., payable Dec. 21.
- \*Lower Perak Tin Dredging.—1s. 3d., payable Dec. 14.
- †M.T.D. (Mangula).—6d., payable Dec. 30.
- \*Minerals Separation.—4d., payable Dec. 9.
- \*Mountain Copper Co.—6d., payable Dec. 13.
- \*New Broken Hill Consolidated.—1s., payable Jan. 2.
- †New Guinea Goldfields.—3d. Aust., payable Dec. 15.
- New Jagersfontein Mining and Exploration.—Half-yearly 6d., payable Jan. 28.
- †Rand Selection Corporation.—1s. 9d., payable Jan. 3.
- Rhodes' Copper Refineries.—Pref. 2½%, payable Dec. 30.

Shareholders of the RIO TINTO COMPANY have been informed that letters patent were issued to PRESTON MINES on August 31, 1960, giving effect to the amalgamation of PRESTON EAST DOME MINES and STANLEIGH URANIUM MINING CORPORATION. Operations at the Stanleigh uranium mine ceased on November 30 in accordance with agreements entered into with RIO ALGOM MINES and ELDERADO MINING AND REFINING.

### Consolidated Gold Fields of South Africa.

At an extraordinary meeting of the Consolidated Gold Fields of South Africa to be held on December 15 it was proposed that a capitalization issue of one new fully-paid ordinary £1 share should be made for every ten ordinary shares issued. The company's accounts for the year to June 30 show a profit of £3,187,822 and £4,774,374 available. Dividends, equal to 5s. on the ordinary shares, require £1,578,645.

Rhokana Corporation.—Pref. 2½%, payable Dec. 30.

\*Selection Trust.—3s., payable Jan. 6.

\*Siamese Tin Syndicate.—6d., payable Dec. 16.

†South African Townships, Mining, and Finance.—1s. 6d., payable Jan. 3.

†Sungei Besi Mines.—3d., payable Jan. 13.

†Sungei Way Dredging.—10%, payable Dec. 31.

Tanganyika Concessions.—Pref. 4%, payable Jan. 31.

\*Tongkah Harbour Tin Dredging.—2s., payable Jan. 4.

†United Tin Areas of Nigeria.—7½%, payable Dec. 15.

### METAL PRICES

Dec. 8.

Aluminium, Antimony, and Nickel per long ton;  
Chromium per lb.; Platinum per standard oz.;  
Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home) .....	186	0	4
Antimony (Eng. 99%) .....	200	0	0
Chromium (98%-99%) .....	7	2	
Nickel (Home) .....	600	0	0
Platinum (Refined) .....	30	5	0
Silver .....		6	7½
Gold .....	12	12	7
Wolfram (U.K.) .....			
(World) .....	7	10	6

Tin  
Copper } See Table, p. 368.  
Lead  
Zinc

# New Gold Plant on the Rand

L. A. Waspe

## General

The new centralized gold plant of East Rand Proprietary Mines, Ltd., has been sited at the Central Shaft mainly because about 50% of the ore supply to the plant will be drawn from the workings served by that shaft. The balance is to be conveyed by surface ore-trains from the other producing shafts of the mine and, as shown in the accompanying flow-sheets, discharged into the relevant transfer-bin. Construction of the plant has proceeded in one stage to the full capacity at present projected, which is about 200,000 tons a month. With relatively minor extensions this capacity could be raised to about 250,000 tons monthly.

Expectations that this most modern plant of the old Witwatersrand sector of the South African goldfields would incorporate the most up-to-date equipment—installed in a metallurgical layout of well-considered, compact, and streamlined design—are fully realized. The objectives of ease in administration and control and operational and replacement maintenance appear to be realized to an outstanding degree. (Where the one is going to end and the other to begin will probably be disclosed after the plant has been running for sometime.)

The following points of interest in the plant are noted :

(1) *Constructional*.—To reduce structural maintenance to a minimum (especially that relative to painting against rust and corrosion) the various structural housings and floorings, tanks, silos, storage bins, and sumps are respectively and relevantly of brickwork and reinforced concrete. The use of steel is limited to the immediate supports of plant and machinery, to the gantries (which have wooden walkways), to the upper walkways of grating in the mill and the mill launder-covers on the floor, to the sumps for the mill effluents, the Brown tanks, and the lime-solution tank.

(2) *Instrumentation*.—This is extensive and

The centralized plant  
at East Rand Proprietary  
is described.

includes the maximum use of automatic titration, weightometers, and weightographs and of alarm-and-trip systems. Centralized control and inspection panels are provided in both the screening-sorting-crushing section and in the administrative and control office section mentioned later.

(3) *Layout*.—The compact layout provides ready and in most essential requirements immediate access to the various sections, especially from the administrative and control office section to those points where close supervision would most be wanted—namely, the crushing and screening circuits (which includes the sorting and reef-picking belts) and, more particularly, the mill and the filtering-precipitation-smelting circuits, which are housed under one roof, and the chemical mixing-dissolution and distributing circuits which flow from a single centralized point. The administrative and control offices are concentrated and housed in what is in effect a deep wall ; these are arranged in tiers and provide an immediate view on both sides—on the one of the milling section and on the other of the filtering-precipitation-smelting circuits—very much like a double-sided ship's bridge. This office section also includes a visual and inspection set of control panels of the flow and its state through various sections of the plant.

(4) *Labour*.—The operational labour complement is as follows :—

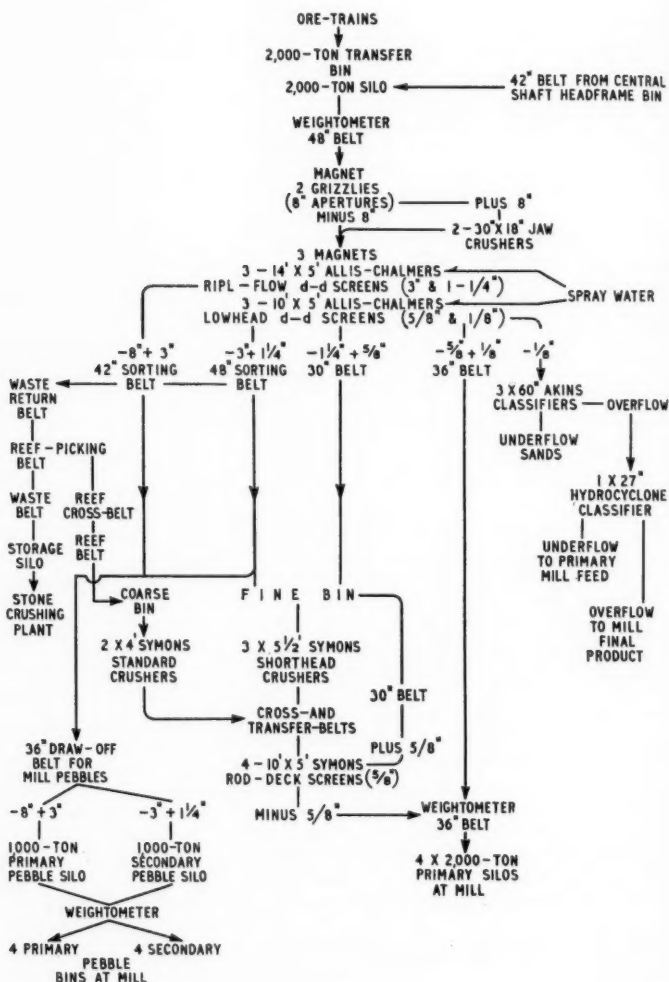
(a) Screening-sorting-crushing section. This is operated on two 8-hr. shifts per day, two Europeans and 157 natives being employed per shift, including 120 on sorting and 10 on reef-picking. The sorting rate will be relatively high owing to the longwall method of stoping and the mining of all ore in the stope in contrast with selective mining methods.

(b) Milling sections. On the three 8-hr. shifts per day one European and six natives will be employed per shift.

(c) Cyaniding-filtering-precipitation. On the three 8-hr. shifts per day one European and 12 natives will be employed per shift.

(d) Smelting. On one 8-hr. shift per day two Europeans and two natives will be employed.

**Flow-Sheet :**  
**Crushing-Sorting-**  
**Grinding Section**  
 (26 days per month).



(c) Administration and control. One European shift-boss per 8-hr. shift with one European reduction officer, one European assistant reduction officer, two European technical assistants, one European clerk, and three natives.

#### Screening-Sorting-Crushing Section

Flow-sheet No. 1 illustrates the circuits of the section. All the heavy-duty main belts are equipped with tandem drives and constant-tension compensating pulleys. Immediately below the sorting belts are the return belts on to which the waste rock, sorted from the ore, gravitates through chutes. Waste-rock bins have been dispensed

with. The waste rock is transferred to a cross-belt, from which reef is hand-picked. This belt is equipped with a scintillometer to indicate the approach of reef, which is additionally tested by the reef-pickers with hand-held Geiger counters. The reef so picked gravitates through chutes on to another cross-belt, which delivers to an incline belt feeding the coarse-ore bin. It is estimated that up to about 20% of the run-of-mine feed to the plant will be sorted and removed as waste rock and sold to crushed-stone contractors.

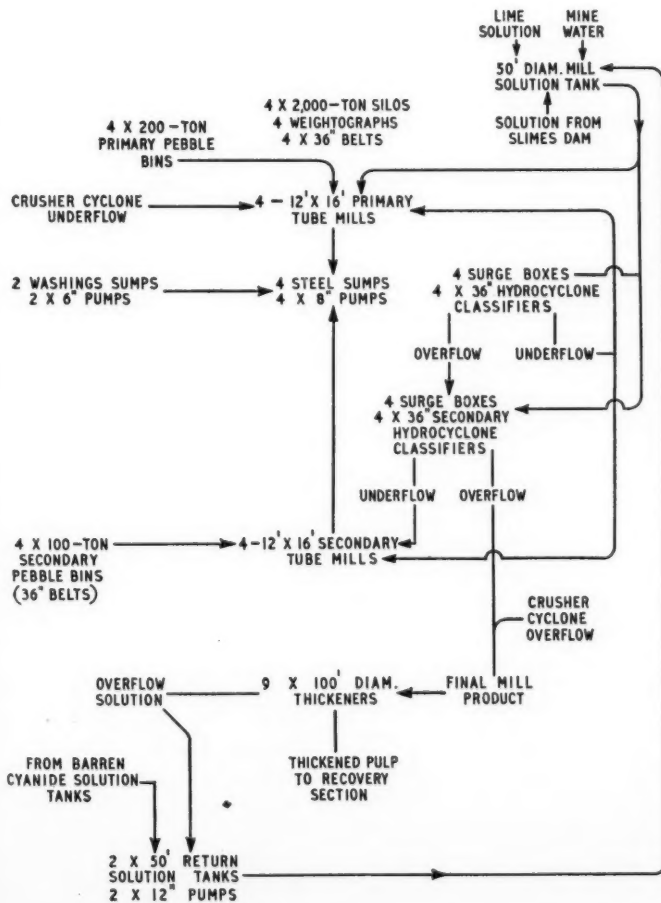
In general the flow through the section

is continuous, the equipment and layout suggesting simplification of operations and control to a high degree. A visual inspection and control panel has been installed and is linked to an automatic alarm-and-trip system. The panel indicates the location of faults and blockage choking.

The sunken transfer-bin to receive the ore discharged from the ore-trains has a draw-off tunnel equipped with 14 gravity chutes with ball-and-chain flow-control and adjustable discharge lips. These chutes are in line with the two draw-off chutes under the silo, which two chutes are equipped with Syntron electromagnetic feeders.

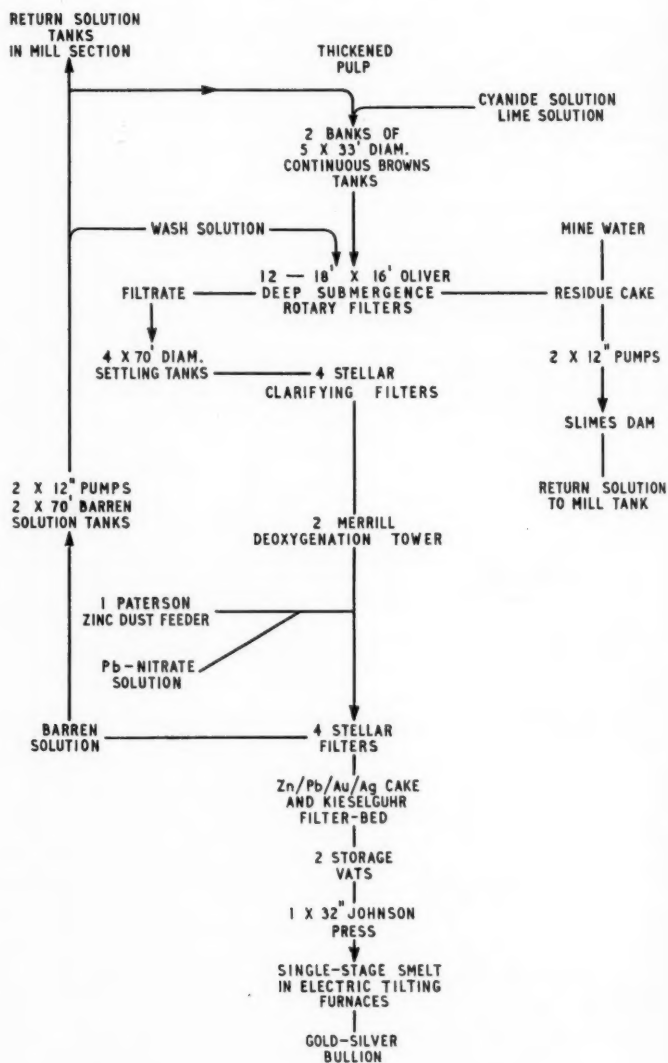
The flow-sheet shows that the reduction of the run-of-mine ore in this section of the gold

plant is carried to *minus*  $\frac{5}{8}$  in., which later may be reduced further to *minus*  $\frac{3}{8}$  in. This relatively high degree of reduction reflects the advanced performances and efficiencies of the modern crusher, screen, and conveyor equipment and is calculated to give a mill-feed permitting grinding in all-pebble mills. This suggests that group metallurgical policy and practice considers it more economic on present and predictable grounds to incur relatively higher costs in the crusher section to achieve relatively lower milling costs than would be possible in rod- or ball- or composite-load mills. The fine product delivered to the mill presents a greater grinding surface in the aggregate than would obviously be presented in a coarser feed.



**Flow-Sheet :**  
**Milling Section**  
(26 days per month).

**Cyanide Recovery**  
Section : Calendar  
month operation.



As and when required a portion of the *minus* 8-in. *plus* 3-in. or the *minus* 3-in. *plus* 1½-in. product will be diverted from the chutes at the end of the sorting belts on to the 36-in. belt for delivery to either of the two pebble silo banks at the mill.

Water for the screen sprays is to be supplied from the mill tank and will be weakly cyanide (about 0.015% NaCN) and alkaline (about 0.015% CaO). A rubber-lined pump

will elevate the spiral classifier overflow to the hydrocyclone classifier in the section.

### Milling Section

The circuits shown include eight large-diameter mills and are to be operated as four independent milling units. Each unit comprises one primary and one secondary mill, with a common effluent steel sump mounted at floor level from which sump an 8-in. sand

pump elevates the pulp to a primary hydrocyclone classifier. This classifier is operated partly in closed circuit with both mills and partly in series with the secondary hydrocyclone, the underflow from which gravitates to the secondary mill. The overflow from the secondary hydrocyclones constitutes the final mill product which is expected to run at 70% minus 200 mesh Tyler. Each pair of units is served by a sub-surface sump fed by mesh-covered launders which collect pulp washings from the mill load dropped for relining or floor-washings at other times. Each sump is served by a 6-in. pump which delivers the washings to the mill effluent sumps, whence the washings are transferred back into circuit. Each primary mill is fed from a silo and a pebble-bin and with the crusher hydrocyclone underflow, the circulating load consisting of a portion of the primary hydrocyclone underflow. Each secondary mill is fed from a pebble-bin, the rest of the feed consisting of part of the primary hydrocyclone underflow and the secondary hydrocyclone underflow. The delivery of the pebbles from the bins is controlled in all cases by Syntron electromagnetic feeders and Williamson controllers.

No provision is made for the removal and disposal of mill reject pebbles, as reduction of pebbles and crushed ore is to be carried to sizes permitting handling by the mill sump pumps and the hydrocyclone classifiers. The mills are fitted with flat liners and scoops, without lifter bars, to promote grinding by attrition.

The mill solution will be maintained at an equivalent of about 0.015% CaO and will be weakly cyanide.

#### Cyanide and Recovery Section

The circuits of this section incorporate interesting installations new to South African gold metallurgical practice. Instead of sand clarifiers settling tanks are used in series with a bank of Stellar filters to clarify the pregnant filtrate from the rotary filters. The settling tanks are 70 ft. in diameter with conical bottoms and floating decanters. They function partly as storage tanks and partly as preliminary clarifiers by normal settlement under gravity of the suspended solids. The solution is transferred through the decanters by 6-in. pumps to the four clarifying Stellar filters which can be operated manually or under full automatic control. This is effected on a time-pressure basis in respect of the operating cycle of kieselguhr filter-bed forma-

tion, filtering, cut-out, the dropping of the filter-cake, and its discharge.

Following the addition of zinc dust by a Paterson dry-feeder unit, and of the lead nitrate solution to form the Zn-Pb couple for the precipitation of the gold and silver, the precipitate is filtered off from the barren solution in another bank of four Stellar filters. Like the clarifying filters this second bank can also be operated manually or automatically.

In test runs the Stellar filters have given outstanding results in the filtering off of the precipitated gold-silver-zinc-lead slime. A barren filtrate assaying 0.001 dwt. a ton has been reported in the test runs against the operational average of about 0.02 dwt. from current installations.

The filters installed in the gold plant are equipped to sample the effluent every 2 min. in a by-pass system by means of an opacity meter capable of detecting turbidity of the order of one part suspended matter per million of solution. On scanning turbidity in excess of that order the meter automatically shuts down the affected filter. The dropped cake is discharged into the storage vats, following which the slime precipitate is filtered off in the Johnson presses.

In this installation the precious slime is manually handled only once—in the removal from the presses. A single-stage smelt is then conducted, without sintering or sulphuric acid treatment, at approximately daily intervals. This procedure provides very much greater security than the current conventional practice and gives the management the gold recovery at much shorter intervals than has so far been possible. This obviously facilitates closer statistical and general administrative control of operations throughout the mine and obviates that lock-up of gold and silver (and therefore of revenue) which is concomitant with Merrill precipitation units over relatively much longer periods.

#### Synthetic Diamond Grit

Further details concerning the manufacture of synthetic diamond grit by De Beers Consolidated in South Africa have been released. The Diamond Research Laboratory reports that the bond employed is a sintered metal powder, the diamond grit sizes employed being from 100 $\mu$  to 250 $\mu$ . Grinding wheels are made in metal, resinoid, or ceramic (vitreous) bonds, the grit sizes employed in this case ranging from 250 $\mu$  to 44 $\mu$ .

# Flotation Froth Level Detector

J. H. Pownall, A.R.S.M., B.Sc., A.M.I.M.M.  
P. L. Palmer, B.Sc.

A description of new  
device now past  
the testing stage.

Work on the automatic control of mineral treatment processes in progress at Warren Spring Laboratory includes the development of sensing and control instruments. One new sensing device, an automatic froth or liquid level detector, has now passed laboratory tests successfully. The instrument, intended for installation in plants, will locate froth or liquid level in a tank and transmit an electrical signal, proportional to the level, to either a remote position or a controlling device which will regulate the level.

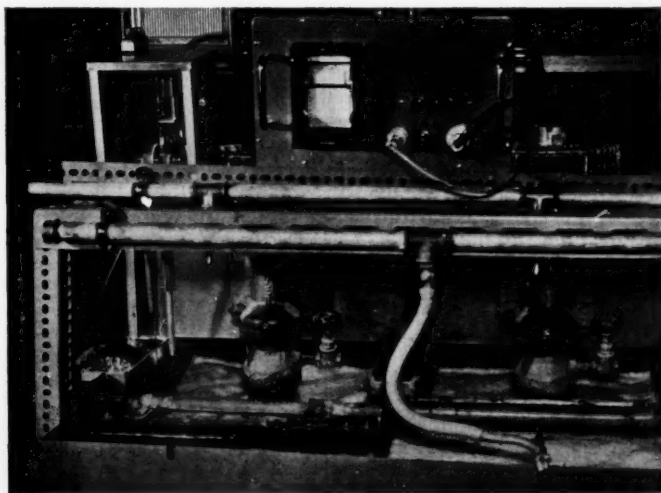
The instrument, which is the subject of a patent application,<sup>1</sup> consists of two units—a detector head, mounted directly above the interface to be monitored, and a control unit which may be placed at some distance from the detector. The detector head contains a conducting probe and one or more potentiometers driven by a single electric servo-motor. The probe, which makes contact with the froth or liquid, can be fitted with a specially-shaped tip to facilitate froth drainage and prevent deposition of solids. Tests with

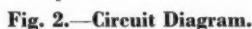
<sup>1</sup> Provisional Patent Application No. 40229/1960.

heavily-loaded froths have shown that the the probe tends to clear itself of deposits of mineral from the froth. The control unit contains a pair of change-over contacts operated by an electronic relay circuit, power supplies, and, if required, a chart recorder. Fig. 1 shows the instrument fitted to a flotation cell; Fig. 2 shows a circuit diagram.

Operation of the instrument depends upon the ability of many froths and liquids to conduct a small electric current. The probe unit and the bulk of the liquid or froth form a pair of contacts in an electrical circuit controlling the operation of the servo-motor. When the unit is switched on the motor moves the probe in the direction of the interface until contact is made. Then a small current flows in a circuit completed through the probe, the bulk of the liquid, and the control unit. This current is amplified and used to operate the relay which reverses the rotational direction of the motor; in turn, this moves the probe away from the interface. As soon as contact between the probe and

Fig. 1.—  
Level Detector  
in Operation.





This work forms part of the programme of the Warren Spring Laboratory and is published by permission of the Director.

## United States Chromite

Details regarding ore-dressing tests conducted by the United States Bureau of Mines on chromite specimens from three areas of the Pacific north-west are given in a Report of Investigations 5646, "Flotation of Pacific Northwest Chromite Ores." The research centred on flotation methods to recover the chromite from fine-grained disseminated ores which came from the John Day region of Grant County, Oregon, the Twin Sisters area of Skagit County, Washington, and the Mouat chromite deposit of south-central Montana. The Mouat ores are from what is known as the Stillwater complex, along the north flank of the Beartooth Mountain Range, which contains the largest known chromite deposits in the United States.

# Modern Computing Methods<sup>1</sup>

T. L. Thomas, M.B.E., Ph.D.

A brief account  
of principles  
with notes on  
machines available

## Desk Calculating Machines

These are the machines which are used most frequently by the mining engineer. Addition, subtraction, multiplication, and division can be carried out rapidly with little mental fatigue and the larger machines will work to ten significant figures. An excellent example of machine computation lies in the calculation of ore reserves and in the more general problem of mine valuation where logarithmic methods would be extremely tedious.

All desk calculators possess the features illustrated in Figs. 9a and 9b which are described below :—

(i) A Setting Register (SR) is combined with a Totals or Product Register (PR) and numbers are set into SR in the usual manner. When the operating handle is rotated once (this operation may be controlled electrically) the number in SR is

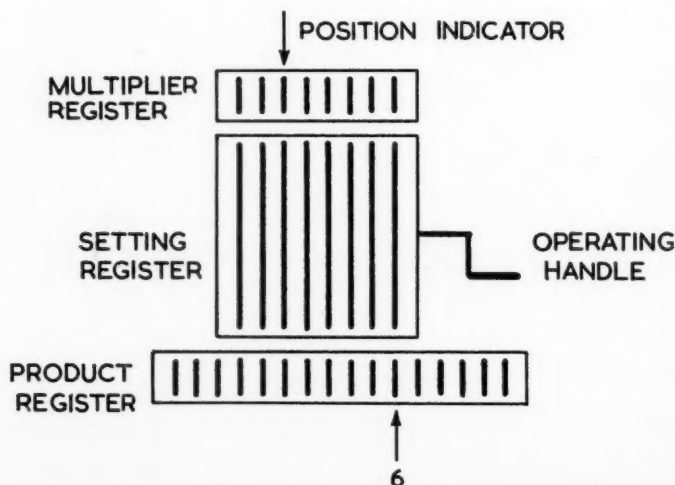
transferred to PR. The Product Register is much larger in capacity than the Setting Register and one of these registers can be moved from side to side relative to the other; in Fig. 9a the right-hand or units column of the SR engages with the sixth window of the PR and the machine is in *position six*. In Fig. 9b the machine has been moved to *position four*.

(ii) A third register called the Multiplier Register (MR) appears on all desk calculators. It is combined with a Position Indicator which indicates the window in the MR (counting from the right) corresponding to the position of the machine (position six in Fig. 9a). The multiplier register counts the operations of the machine in the position indicated by the position indicator. Thus in Fig. 10a, with the machine in position six, if it is operated *three* times, MR indicates 3 in window six and the number in SR (3821) is transferred three times into PR giving the result :—

$$3,821 \times 300,000 = 1,146,300,000$$

<sup>1</sup> Concluded from the November issue, p. 275.

Fig. 9a.



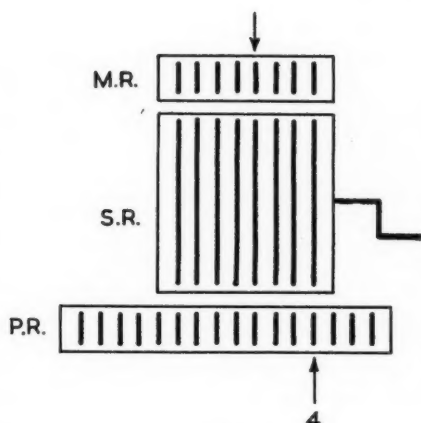


Fig. 9b.

"3821" has been added three times in the sixth position which is, in effect, multiplying by a six-figure number. If the machine is now moved to position four and it is operated seven times (Fig. 10 (b)), "3821" is transferred seven times into PR in this position and MR indicates 7 in window four. PR shows the total of the two operations and the multiplication —

$$3,821 \times 307,000 = 1,173,047,000$$

is indicated in the registers of the machine. In this manner any multiplication can be worked out. Having set the first number into

SR, the second number is entered into MR by moving the position indicator and operating the machine; PR will then show the product of the two numbers.

(iii) If two numbers are multiplied as described above the result is given in PR. If MR and SR are cancelled and another product entered into the machine without cancelling PR the sum of the two products will be found in PR and so on. In this manner a sum of products—

$$P = a \times b + c \times d + e \times f + \text{etc.}$$

can be worked out directly on any desk calculator. This property is extremely important since in numerical work such formulae occur very frequently.

#### Example 1

1,328 articles at £5.28651	Total Cost
115 " " £10.31724	= £19253.385
728 " " £15.117365	= £19,253 7. 8½.

#### Example 2

4.4 pennyweights over 6.5 in.	Total
8.9 " " 5.6 "	= 196.61 in.
9.2 " " 8.7 "	pennyweights
4.1 " " 9.3 "	

(iv) In order that a product may be subtracted from PR the operating mechanism (the handle in Figs. 9a and 9b) can rotate in both directions and for this reason MR must count in both directions. For this purpose a lever is provided on most machines which reverses the direction of counting in MR. Some manufacturers, notably Brunsviga and

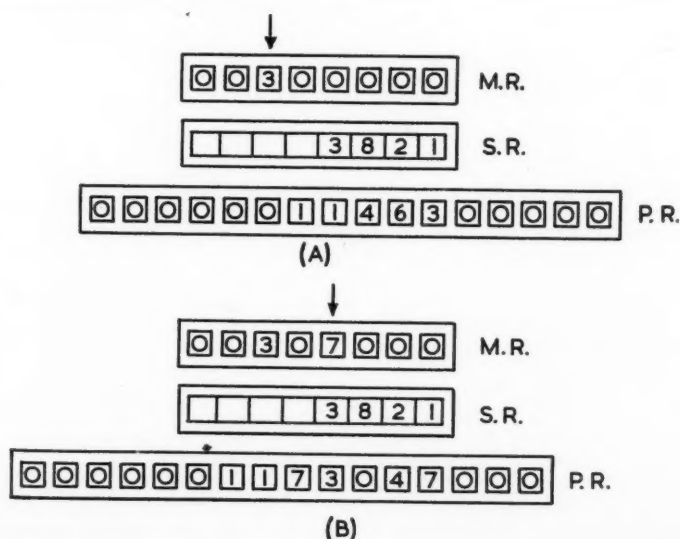


Fig. 10.

Facit, have made this operation automatic and MR counts in the direction specified by the first operation of the machine after MR has been cancelled—this is a most helpful feature—and an indicator is provided to show the chosen direction.

(v) Since products can be deducted from a total in PR it is clear that the final result of a series of operations can be positive or negative. To illustrate this consider the simplest case when PR is initially zero and a product of two numbers is multiplied negatively on the machine.

Enter the first number (81257) into SR and set MR to count negatively. Turn the second number (4872) into MR, using the position indicator and operating handle (as already described). The result will now be found in PR as follows:—

```

      00004872 MR (negative)
      00081257 SR
9999999604115896 PR (negative)
      ↑
  [ Bridge
  of nines ]

```

and we see that negative numbers appear as complements. In order to obtain the numerical negative value each digit is subtracted from 9, except the last non-zero digit which is subtracted from 10, thus—

0000000395884104—negative

is the correct numerical result. (See "Adding Machines").

When PR changes from positive or zero to negative tens transmission takes place right across the product register to form what is known as the "bridge of nines" which indicates that a negative or complementary number is being built up. The complete bridge of nines appears or disappears only when PR passes through zero and on many hand-operated machines this is further indicated by the ringing of a bell.

This method of displaying negative numbers may appear to be rather awkward but it is in fact a most important feature of machine computing. Suppose a number A (31428, say) is first entered positively into PR and another number B (74136, say) is then entered negatively, the bridge of nines will be formed only if B is greater than A, as in the above example. In this manner the machine will compare two numbers and decide automatically which is the greater—a very simple decision, but one which is at the root of all automatic computing.

(vi) By setting the divisor into PR and the dividend into SR division can be performed on any desk calculator by reducing PR to zero using the bridge of nines to indicate when zero is passed. Automatic division, which is built into almost all electric calculators, is the simplest example of a machine choosing between two possible programmes and following a sequence which cannot be specified before the problem starts. Consider, for example, the following situation when the numbers to be divided have been entered into the machine:—

```

      ↓ Position 6
0000000000 MR. (Counting negatively)
00014862 SR.—Dividend
0003776500000 PR.—Divisor

```

When the division bar is depressed the machine makes an *unknown* number of turns backwards until P.R. passes through zero:—

```

      ↓ Position 6
003000000 MR.
00014862 SR.
[ switch ] → 9999999317900000 PR.

```

When the left-hand nine of the bridge is formed it operates a switch causing the machine first to stop and then to take one turn forwards:—

```

      ↓ Position 6
002000000 MR.
00014862 SR.
0000000804100000 PR.

```

The position indicator is now moved to the next position (5, in this example)

```

      ↓ Position 5
002000000 MR.
00014862 SR.
0000000804100000 PR.

```

and the machine continues to rotate backwards until zero is passed in this new position and so on. It should be noted that when the machine is required to make a decision it is impossible to state at the beginning of the problem how many turns the machine will make in each position. This example is given in detail since it illustrates the process of "thinking" in digital computing which in a large computer can lead to such remarkable results.

All desk calculators will carry out the basic operations described above, so that addition, subtraction, multiplication, division, and the addition of a sum of products are all carried out directly without the necessity for writing down intermediate results. The potential user will find a large number of machines available each with its own particular features and the following classification is

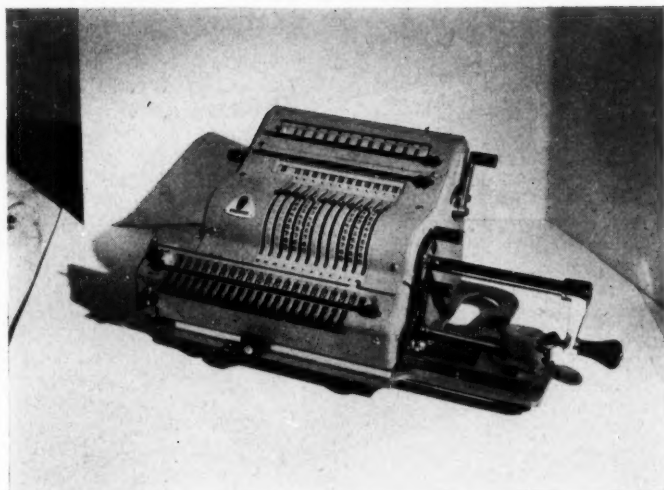


Fig. 11.

intended to cover the more important of these.

*Setting Registers.*—The three basic types have already been described (see “Basic Components of a Calculating Machine”) and they are all used on desk calculators.

The lever type illustrated in Figs. 11 and 16

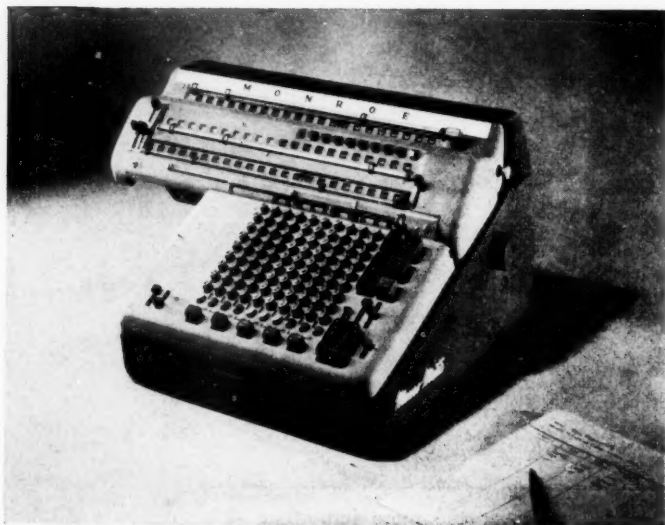
is compact and flexible and it is still used on special machines like the Brunsviga twin or triplet and the Curta, where size is of great importance. Lever set machines are also cheaper.

The keyboard type illustrated in Figs. 12, 13, and 14 is very popular in America and is



Fig. 12.

Fig. 13.



flexible in that entries are easily corrected and the setting register can be altered during the course of a calculation. Non-decimal quantities—such as, pounds, shillings, and pence, or hours, minutes, and seconds—can also be dealt with rather better than with other types.

The ten-key register illustrated in Fig. 15 is increasing in popularity. It is very suitable for rapid entry by touch, but it has the disadvantage that a number once entered must be removed before it can be altered or corrected.

**Capacity.**—The capacity of a machine is given by writing down the number of digits which can be entered into each of the three registers, thus:—

$$\left. \begin{array}{l} 10 \times 8 \times 16 \\ \text{SR. MR. PR.} \end{array} \right\} (= \text{Eight significant figures})$$

In general if half the number of windows in the product register is taken this will give the number of significant figures to which the machine is capable of working.

A setting register with at least ten places is very useful, since it is then sufficiently large for it to be split into two or more sections, an operating device which can be used in many ways, but apart from this six or seven significant figures are sufficient for most purposes and a capacity of  $10 \times 8 \times 13$  (= six significant figures) will meet most requirements.

The largest capacity normally available is  $10 \times 10 \times 20$  (= ten significant figures)

and very few problems are met which utilize this to its full extent. Nevertheless, large-capacity machines are very popular since the setting up of any problem requires very little thought—decimal points, for example, can be set up permanently for all calculations.

**Manual or Electrical Operation.**—Hand-operated machines are cheap, robust, reliable, portable, and require no power supply (see Figs. 11, 12, and 16). Electrically-operated machines require less physical effort and many special devices are incorporated designed for specific tasks.

In the hands of skilled computers the actual rate of calculation is not very different and in a number of instances the hand-operated machine is faster than its electrical counterpart, but for lengthy routine operations the electrical machine reduces physical and mental labour.

The potential user should not be over-impressed by a spectacular array of control buttons. The correct method of selecting a machine is to arrange for a representative demonstration by skilled operators who can point out any special features which may assist in the solution of a particular problem. Reputable manufacturers will always supply the machine in their range most suitable for the job in hand and for this reason full details of what is required should be supplied, if possible, several weeks before the demonstration.

**Transfer.**—This important feature is now

becoming standard on more and more machines and all those illustrated in Figs. 11 to 15 possess it. The automatic transfer of numbers from one register to another is extremely useful, but by far the most important transfer is from product register to setting register since the following additional operations are then available.

(a) A negative or debit amount, which is displayed as a complement can be transferred from PR to SR and re-entered negatively into PR, thus enabling the operator to read out *directly* the correct negative result.

(b) By transferring a product "a.b." from PR to SR, this amount can now be multiplied by "c," thus giving a result a. b. c, and so on. In this manner the product of any number of factors can be formed.

*Example.*

$$(1.2345)^2 \times (1.8367)^3 = 9.4427$$

In addition to the above transfer the machine illustrated in Fig. 14 has transfer from PR to storage and from storage to PR. The machine in Fig. 15 has transfer from PR to SR and from MR to SR.

*Storage.*—This is another important feature which is available in various forms on the machines illustrated in Figs. 11 to 14. Enormous storage capacity combined with transfer is the main secret of digital computers and although storage space in desk machines is usually very limited, it is

surprising how many calculations are simplified if a single storage register is available. It should be possible to transfer results from storage to PR or SR and the machines in Figs. 11, 12, and 14, possess this feature.

*Automatic Multiplication.*—This is available on a number of electric machines in two forms:—

(a) The first number is set into SR in the usual manner. The second number is fed, a digit at a time, into a separate keyboard. As each digit is entered, the machine makes the number of operations indicated by the digit and moves the carriage in readiness for the next instruction. In this way multiplication is complete as soon as the second number has been entered. Without a doubt this is the fastest method of automatic multiplication and it is incorporated into certain Diehl (Fig. 14) and Marchant machines.

(b) The two numbers to be multiplied are entered into two registers and the start button is depressed after which the machine will complete the multiplication automatically. Although the method is slower it is extremely popular and most automatic systems operate in this way. Although two separate registers are required entry of the two numbers may be *via* a single keyboard as in the Monroe (Fig. 13).

*Automatic Division.*—This is available on almost all electric machines and the principle

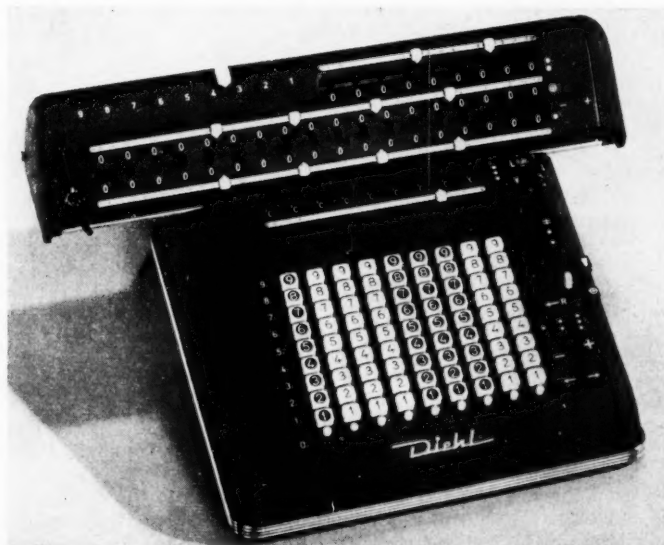


Fig. 14.

employed has already been explained. The hand-operated Madas 10 R (Fig. 12) is unusual in possessing automatic division, and the Diehl (Fig. 14) employs a slight variation of the usual system which increases the rate of operation by about 20%.

### Special Features

Many other special operating features are available especially on electric machines and the most important of them are described in the following paragraphs:—

**Double Product Register.**—Products can be entered positively or negatively into a second product register, while they are being built up in the normal product register. In this manner the second PR can be used for storage purposes. Transfer from this register is not provided on existing machines (Fig. 13).

**Double Multiplier Register.**—One of these registers can be employed to sum multipliers (Fig. 13).

**Automatic Squaring.**—Very useful in statistics since a sum of squares can be formed faster than on any other type of machine.

**Automatic Tabulation.**—The machine returns to a selected position after each calculation in readiness for the immediate entry of the next pair of numbers.

**Non-Repeat Key.**—When this is depressed the keyboard clears after each operation of the machine. The addition or subtraction of numbers is simplified when a non-repeat key is available.

**Automatic Entry of Dividend.**—A dividend is transferred from the keyboard to a suitable position in PR, while MR and SR are cleared.

**Automatic Clearing of Registers.**—After completing a multiplication, for example, MR and PR are cleared and the machine returns to position one: Other forms of automatic clearance are also available.

**Automatic Square Roots.**—One make of calculating machine (Friden) has built into it a programme for the calculation of square roots.

**Product Counter.**—When a large number of products is being summed it is useful to know at any stage how many have been entered. The product counter provides this information.

**Independent Entry into Registers.**—It is often useful to be able to enter numbers into registers other than the setting register without operating the calculator. This is

possible on a number of machines (Figs. 11, 12, and 14).

### Special-Purpose Machines

The twin and triplet Brunsviga calculators were designed especially for surveying and photogrammetry. They consist of two or more standard machines linked together. The triplet can also be used to work out numerical results with imaginary numbers. The Curta calculator is special only by reason of its small size: The Model II which can be carried in a coat pocket and is held in the hand has a capacity of  $11 \times 8 \times 15$  (Fig. 16).

Almost all the features described above are incorporated into a new Archimedes Diehl machine introduced early in 1960. In addition to two storage registers and four transfers the machine will work out any integral power (including squares) automatically. This is most useful in valuation problems when an unusual rate of interest is being employed.

### Punched-Card Equipment

Consider an ordinary well-shuffled pack of 52 playing cards. The labour involved in arranging them into their correct numerical sequence is quite considerable. Sorting problems of this kind appear in science and industry in many forms—indexing and filing and statistical analysis, for example, all present problems of sorting which if carried out manually would be costly, tedious, and time consuming. The ability to sort packs of cards which have been suitably punched is one of the chief tools available in the punched-card system.

Fig. 17 shows a card divided into ten rows numbered 0 to 9 and twenty columns numbered 1 to 20. It is possible to punch a hole into any one of the ten positions in any column and in Fig. 17 a hole has been punched in row 3 col. 3, row 5 col. 5, and row 1 col. 7. By punching holes in this manner each column can be used to represent any digit 0 to 9. Thus, using the first six columns, if we punch holes as follows:—

Column 1 2 3 4 5 6  
Row No. 5 8 0 9 2 6 (Holes are punched in these rows) then the six figure number  
580926

is represented on the first six columns of the card.

The sorting device accepts the cards one at a time and the sorting process operates on one selected column. Suppose, for example,



Fig. 15.

column five is chosen : The card is accepted and an electrical (or mechanical) feeling system makes contact only in the row in column five where a hole has been punched and the card is delivered to a collecting position corresponding to the number of the row punched. Thus in Fig. 17 the card would be delivered to the fifth collecting position and in the example given above the card would be delivered to the second collecting position. The cards pass through the machine at a rate of about 5,000 an hour and after one sorting operation in column five all the cards with a hole punched in the zero row will be collected together and so on. All the cards in any one position can easily be checked, since, when stacked, a rod can be passed through the common punched hole. A sorting machine is illustrated in Fig. 18 where the collecting positions can be seen clearly. If required the machine will collect cards in one position only, all other cards being discarded.

If the first five columns (say) of a card are used for punching a reference number then the sorting machine will enable a pack of such cards to be arranged in order in the following manner :—

The pack is first sorted in the first column and all the ten resulting piles are arranged in order. This re-arranged pack is then sorted on the second column and the same process is continued for the five columns, when the whole pack will be in numerical sequence. By collecting in one position any card or



Fig. 16.

group of cards in the pack can be located automatically in a somewhat similar fashion.

In order to make full use of the sorting technique described the columns of the card not used for reference purposes are used for storing numerical and other information relating to the reference number. In payroll applications, for example, the reference number would refer to an employee and the remaining columns, split into groups or fields, would give information, numerical and otherwise, referring to the employee. Several machines are available for processing this information and the more important of these are given below.

**Punch.**—Cards used in practice would have possibly 80 columns and the punch is used to enter data on the card by punching holes as already described. A ten-key setting register is employed (see Fig. 3). A digit is entered into any row by depressing the corresponding key. This causes the hole to be punched in the correct position and the card moves on to the next column.

For sterling calculations the numbers ten and eleven are required separately and two additional rows appear on each card which are used for this purpose. Furthermore, by punching two holes in a column following a suitable code, the letters of the alphabet can be represented and the keyboard of a punch contains keys for entering all these items.

**Verifier.**—It is imperative that information is entered correctly into a card. When a pack of cards has been punched it is passed to the verifier, where the entries are made on an identical keyboard; if any entry does not agree the card concerned is rejected. All cards passed by the verifier receive a special punch without which they will not be accepted in other machines.

**Interpreter.**—It is easy to read off the information contained on a card, since the code employed even for letters of the alphabet can be committed to memory. The interpreter, however, accepts each card and prints the information it contains in one line across the top of the card. This is most useful when a particular card is referred to manually.

**Sorter.**—This is the machine whose purpose has already been described above which carries out the sorting operation.

**Collator.**—This machine accepts two packs of cards which have already been sorted and it will merge these into a single pack in numerical sequence. This feature can be utilized to solve many problems.

**Reproducer.**—The reproducer punches a duplicate pack of cards from an original pack. It will also produce several copies, if required, of a single master card.

**Printer and Tabulator.**—This machine accepts a card and it prints the information contained on the card in one line on a roll of paper. If required only the information contained in selected columns or groups of columns will be printed. In addition the tabulator contains a number of totals registers each of which will accept figures from any group of columns and, as in any adding machine, will form a progressive total. In this manner all the facilities found on adding listing machines are available in the punched-card systems. Any set of totals can be printed, either at regular intervals or at the end of an operation, so that sub-totals and grand totals are printed automatically.

**Calculating Punches.**—Consider a card containing two numbers punched into two groups of columns. The calculating punch will accept this card, carry out a sequence of arithmetical operations on the numbers (multiplication, division, addition, subtraction, etc.), and punch the result either on another section of the same card or on another card. Calculating punches are indeed small-capacity digital computers and the above example is only illustrative of what can be done. In fact almost all digital computers will accept information from punched cards and will punch results (including reference numbers) into other cards so that punched-card systems can utilize all the remarkable properties of digital computers and conversely.

Using the machines described a powerful system is available which has been used extensively in banking, insurance, accounting and in head offices throughout industry. For firms unable to afford all the equipment Data Processing Centres are to be found in all large cities, which will carry out the necessary work. Many firms punch their own cards and send them for processing to the centre. Many scientific problems can also be programmed on punched cards.

Punched cards are now recognized as a stable and permanent method of storing records and new machines are continually being produced by means of which data can be transferred to or from cards—e.g., one machine takes cartesian co-ordinates from a punched card and automatically plots the point on a sheet of paper. In this manner curves of any description can be plotted.

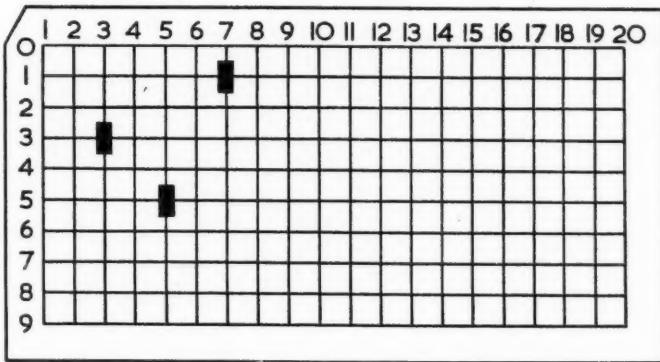


Fig. 17.

Another machine takes accurate measurements from an aerial photograph and punches the results directly on to a card in readiness for further processing.

### Digital Computers

The main principles employed in digital computing have already been explained and 15 years ago it would have seemed unlikely that a further spectacular advance was possible. Indeed the first digital computer was electro-mechanical rather than electronic and its rate of operation was not very much faster than some of the machines already described. This machine was the Harvard I.B.M. Calculator of 1946. The first computers were used purely for scientific purposes and their application to the solution of industrial problems did not become widespread until 1956. Nevertheless a revolution is now taking place and, commencing with large industries, new techniques are being introduced. The reasons for these changes are as follows:—

(i) By using electronic impulses instead of mechanical gears the *rate* of operation has been increased by a factor of several thousand. The time taken for an operation is measured in microseconds—i.e., millionths of a second.

(ii) Almost unlimited storage space is available where data of any kind can be stored. This data is easily accessible at any time and it can be altered or brought up to date.

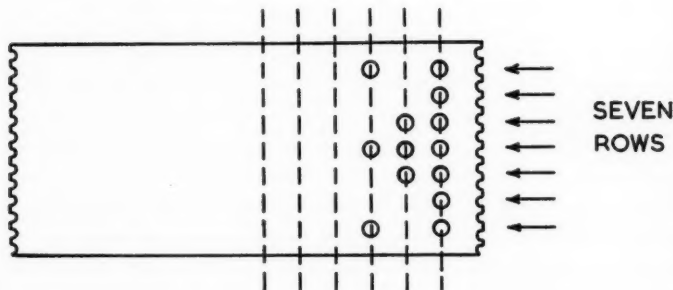
One of the burdens borne by industry and commerce at the present time is the maintenance and upkeep of extensive files and records. The punched-card system was introduced to simplify this problem and punched cards are now recognized as a reliable method of filing information. This

is not the case yet with storage systems, mainly magnetic, used in digital computers, but this is because teething troubles have still to be overcome and insufficient time has elapsed to prove the efficiency of the various systems. In due course the need for external files and records will diminish and the compact storage of information on magnetic tapes or discs or in some other form, will become acceptable. This data can be sorted by the computer; summaries of selected items can be prepared and printed out and so on. In this manner space will be saved and not only will the drudgery of manual filing be



Fig. 18.

Fig. 19.



eliminated but classifications and summaries will be available up to date and on request.

(iii) All internal operations are carried out quite automatically without human intervention of any kind. Any problem resolves itself into a few basic operations which are repeated many times and the machine will follow automatically a sequence of such operations of any length from the initial stage of accepting the data to the final stage of printing out the result.

(iv) In addition to following a sequence of operations the machine can at any stage choose between two such sequences A and B; notice that the sequences A and B must be known beforehand, the machine can only choose between them. The choice is made by subtracting two numbers (calculated by the machine); if the result is positive A is chosen and, if negative, B is chosen (see "Desk Calculating Machines" above).

Arranging a given problem into a sequence of basic operations, with a choice of two predetermined routes at various stages of the calculation, is termed programming and this is the art of digital computing. A programme for a problem occupying a few seconds may take months to prepare, but once prepared it can always be utilized. Manufacturers of digital computers will have available extensive libraries of programmes already worked out and these are of great value when tackling new problems, since many of the commonly-occurring difficulties will already have been solved. Notice that the programmer must prepare every possible sequence of operations beforehand and the machine must be given a rule for choosing between route A and route B at any point. Thus all the machine will do is select the correct route through a problem and, although this route may not be known initially, the programmer must prepare for every alternative. The programming of division on a desk

calculator has been described briefly. When a problem is studied it is surprising how it can be reduced to the terms described.

A brief description is given below of each of the five component sections of a modern digital computer.

*Input.*—Data, from the outside world must be presented to the computer for processing and input devices, of which there are four main types, are for this purpose.

(a) Keyboard.—A keyboard can be employed to present information to the computer. The information is typed by the operator of the keyboard and may consist of letters and numbers, so for this reason the numerical portion of the board will be of the ten-key pattern. The information from the keyboard is usually transferred to paper tape, magnetic tape, or punched cards before it is utilized by the computer.

(b) Paper Tape.—A binary number with seven places can be used to record any decimal number up to 127 (see "Scales of Notation") since—

$$1111111 (\text{binary}) = 127 (\text{decimal}).$$

Thus 127 characters can be coded by using a seven-figure binary number and in this manner the letters of the alphabet, the digits 0 to 9, and several other symbols are represented. A roll of paper (Fig. 19) is punched with holes as shown and it is fed into the computer a column at a time where a scanner senses the positions of the punched holes and interprets the character which is to be read into the computer.

(c) Punched Cards.—Most modern computers will accept data automatically from punched cards.

(d) Magnetic Tape.—A magnetic tape can be coded in a similar manner to paper tape (where a hole is punched in paper tape the magnetic tape would be magnetized). As stated above by using seven positions it is

possible to code 127 characters and this is more than is required for normal usage. The extra positions are used for checking purposes and the code adopted makes it possible to check each symbol as it is entered into the computer.

Information can be stored very compactly on a magnetic tape and this information is read into the computer faster than by any of the previous methods. A fair-sized novel, for example, could be read in a few minutes and a reel of tape could contain all the data required for making out a large payroll.

Magnetic tape is also very useful for the operations of sorting and collating already mentioned and these processes are carried out even more rapidly than with punched cards.

The disadvantages of magnetic tape are: (i) It is expensive and (ii) paper tape and punched cards are accepted in business and industry as satisfactory permanent records. The situation regarding magnetic tape is still rather uncertain mainly because insufficient time has yet elapsed for the complete reliability of the system to be proved.

(iii) Information stored on punched cards is available for visible inspection. A single card can be removed from a file for inspection and alteration or replacement if necessary. Tapes are not so convenient from this point of view and the information stored on magnetic tape cannot be read visually.

*Storage.*—It has already been pointed out how much the power of a desk calculator is increased by the addition of a single storage position with automatic transfer to the keyboard. The punched-card system owes much of its effectiveness to the fact that the punched cards may be regarded as an efficient and almost unlimited store for data. Any item stored can be traced rapidly and automatically and printed out or transferred to some other location.

Punched cards can be used for storage by digital computers, but many other systems have been developed, mainly magnetic. A store consists of a large number of similar positions where numerical data is entered; each position is numbered so that it can be traced automatically and the data transferred to any other location in the machine.

Some storage systems require to be almost unlimited in size and these are usually external to the digital computer in the form of magnetic tapes or discs. Any item in the store is readily accessible, but a position in the middle of a tape, for example, requires a few seconds before it is available to the computer.

Most computers have one or more internal stores from which items can be available in milli- or even microseconds and such stores can contain several thousand eight- or nine-figure decimal numbers. These stores are essential for the intermediate storage of



Fig. 20.

numbers or information during the course of a problem. Magnetic drums revolving at high speed have been used extensively for this purpose and even more rapid access to information is possible by storing the binary symbols in magnetic cores, many thousands of which are assembled together and interconnected by wires. This latter system is now replacing the revolving drums.

*The Arithmetical Unit.*—In principle the arithmetical unit behaves like a desk calculator but at electronic speed. Information is accepted from store, numbers are added, subtracted, multiplied or divided, and the answer is returned to a selected position in store. The operation of the arithmetical unit is completely automatic.

*The Control Unit.*—This is the "brain" of the computer. In most modern machines the control unit reads numbers from storage and interprets them as instructions. For example:—

11 1986 1989

(i) The first two digits of this number represent the instruction to be obeyed.

(ii) The next four digits represent the storage position (called the address) where the number referred to in the instructions is located. Thus instruction No. 11 may mean "Transfer the number in storage to the multiplier register of the arithmetical unit." The computer will then carry out this transfer for the number in storage position 1986.

(iii) The last four digits represent the address in store of the next instruction. In this manner the control unit obeys an instruction and then proceeds to the next instruction and so on.

The example given represents one method of control; there are other similar methods. By utilizing computing techniques already described the control unit can govern the computation of any problem in the following manner:—

(a) The control unit obeys a limited number of commands basic to the computer. The programmer arranges these in a definite sequence and they are set as numbers into storage positions. The basic commands are required to control input, output, storage, and the arithmetical unit; about twenty commands are sufficient for this purpose.

(b) If at the end of a sequence of instructions the control unit is returned to the first instruction the computer will now repeat the sequence and this will go on indefinitely.

In this manner the machine works out a loop of instructions and since the data received from input will differ for each loop the same calculation or formula can be worked out repeatedly and the answers printed out, this being one example of the use of a loop.

(c) At the end of a sequence of instructions the control unit will choose one of two new sequences depending upon the sign + or - of a number in a selected storage position. Suppose, for example, we require the computer to traverse a loop 50 times. The number 50 is set into the given storage position and at the end of each traverse of the sequence of instructions this number is reduced by unity. The machine will now repeat the loop only if the number in this position is positive; otherwise it follows the alternative sequence which could be an instruction to stop. In this manner the computer would calculate a given sequence 50 times and then stop.

(d) Since an instruction is simply a number in storage the computer can be instructed to alter a number in such a storage position. Thus the sequence of instructions can be modified, if necessary, during the course of a calculation.

*Output.*—Magnetic tape, paper tape, and punched cards can all be used as outputs from a digital computer. In addition results can be typed directly by utilizing a printing device such as an electric typewriter operated by paper tape. The rate at which results can be printed is limited by mechanical considerations and considerable research is being devoted to the problem of building high-speed outputs. Fig. 20 shows a modern digital computer of medium size.

### Prospects

No spectacular advance is to be expected in the design of adding machines and desk calculators, although improvements in detail will occur. Printing calculators, combining the advantages of both adding lists and desk calculators, can be developed still further, but any advanced design will encroach into fields which will be covered by the smaller digital computers. The feature of transfer discussed here will be standardized on almost all machines and even now most manufacturers provide at least one model with transfer.

The use of computer storage for the permanent recording of all information is undoubtedly a possibility of the future. Such information is easily accessible and

complicated analyses normally requiring weeks or months can be available on request. Large computers are already being purchased for the exclusive use of big organizations and smaller machines are now becoming available for firms with insufficient work to occupy a large machine but who wish to be independent of Data Processing Centres.

The volume of information is now so great that even the task of preparing it for the computer is a major operation. For this reason research is proceeding on methods

of preparing original records in a form which can be read immediately by machine. In a bank, for example, it would be ideal if cheques, once written, could be bundled together and fed to a machine for further processing. This would require a machine to read handwriting and some co-operation by the original writers would be necessary before such a system could be made fool-proof. The problem of checking signatures is also one which will remain in the hands of human operators for some time.

### Sinking Record at Hartebeestfontein

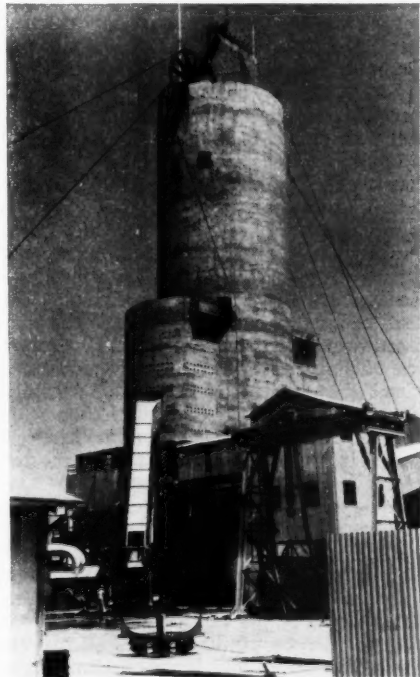
In what is probably the second last major sinking effort in its lease area—No. 4 Shaft in the south-western section—Hartebeestfontein Gold Mining Co., Ltd., established a new world sinking record of 1,106 ft. during October. In traversing 721 ft. of pre-cementated dolomite and bands of shale and chert and 385 ft. of lava the depth of the shaft was advanced from 799 ft. to 1,905 ft. and 3,000 cu. ft. of rock was excavated for a transformer station over the 31-day month.

The shaft, which has an excavated diameter of 26 ft. and a lined diameter of 24 ft., is expected to be sunk another 2,000 ft. or so by the year-end; it should reach the level of the connecting twin-haulage being driven from the No. 2 Shaft system—about 7,900 ft. to the north-east—at 6,400 ft. and then intersect the Vaal Reef at about 6,600 ft. by about mid-1961. No. 4 will be an all-purpose shaft for hoisting men and materials as well as rock and ore and will be downcast for ventilation. Four operating compartments and one service compartment will be provided.

With the completion of sinking and concurrent lining, and then subsequently of equipping, the mine will be served by four shaft systems: No. 1 in the relatively shallow south-eastern section; No. 2, which about 6,900 ft. north-west from No. 1 includes a vertical and sub-vertical component, serves the deeper central-north section and from which the connecting 29 Level twin-haulage is being driven to No. 4; No. 3, which about 2,600 ft. east of the No. 2 system is facilitating development of the north-eastern section, and No. 4 in the south-western section about 7,900 ft. south-west of No. 2. The expected fifth major shaft will probably be sited, if anywhere, in the western or north-

western section to facilitate operations there as well as exploratory development into the extreme eastern section of the Zandpan mine immediately to the west of the Hartebeestfontein property.

After the commissioning of No. 4 Shaft, probably in the earlier part of 1962, it is expected that the milling rate will be advanced further well into the range of 130,000 tons to 160,000 tons a month, if not higher. Over



No. 4 Shaft Headframe.

### Personalities at the Mine :

From left to right,  
G. de Villiers (Gen.  
Manager), M. D.  
Erasmus (Master  
Sinker), M. Tucker  
(Sinking Superin-  
tendent), D. Deacon  
(Asst. Manager).



the four months to the end of October the monthly average milling rate was slightly less than 120,000 tons. Present indications are that the mining of ore in the south-western section will boost the tonnage milled rather than the mill grade and yield, which should not be materially affected. The question of any effect on the mill grade would be of more speculative interest were the western section of the lease area to the north of No. 4 Shaft to be developed in the immediate future. In that section bore-hole results of 602 in.-dwt., 714 in.-dwt., and 15,317 in.-dwt. were announced early this year. If these high values persist over a significant area the average mine grade would be raised very markedly—perhaps as high as the 750-in.-dwt. to 1,550-in.-dwt. range. This, however, is the more distant prospect. Furthermore, the consideration of fault enrichment in the values mentioned above cannot altogether be excluded. Consequently for the immediate future expectations of grade are based on the bore-hole grade range of 245 in.-dwt. to 385 in.-dwt. with a payability range of 50% to 100%. At June 30, 1960, the ore-reserve grade was 8.92 dwt. over 37.8 in. or 337.2 in.-dwt.

### Sinking Operations.

The shaft headframe is of reinforced concrete, 142 ft. high to the sheave platform and has an internal diameter of 36 ft. The two permanent 5,145-h.p. double-drum hoists have already been installed in opposed positions on each side of the shaft, but for sinking

they were commissioned for single-drum operation. The service hoist is 2,300 h.p. In addition there is the 200-h.p. four-drum stage hoist.

*Labour.*—Whites 54 and natives 551.

*Shaft.*—Excavated diameter 26 ft. and lined diameter 24 ft.

*Data, October.*

Feet sunk, 1,106.

Tons excavated per ft. advanced, about 44.

Tons excavated per day, 1,861 on a 42-ft. sink.

Lining; shuttering-lift, 30 ft. at 2 ft. per hr.

Concrete placed, 150 tons per lift.

Galloway-stage, 60 ft. high. Weight, 90 tons, including air-operated cactus-type grab equipment; three main-decks and six cat-walks; four suspension ropes, doubled around stage sheaves to make eight; 1½-in. diameter. Grab, 30 cu. ft. with a cleaning capacity of 300 tons per hr. of broken rock.

Kibbles, 14-ton, two in use, suspended on single 2½-in. ropes.

Sinking round, 104 by 1.75-in. holes per round. Depth of holes, 8.75 ft. and 10 ft. Rock-drills, 30, with tungsten-carbide tipped drill steel. Electric detonation. Multi-cycle operation. Best sinking cycle, 4.25 hr. Tons loaded per hr., best 322, average 280.

*Other Shaft Equipment.*—Eleven service columns comprising two 34-in. ventilation ducts, two 6-in. concrete pipes to stage distributor, two 8-in. compressed-air pipes, four cementation pipes, and one 2-in. water pipe.

*General.*—85,000 tons of air were circulated for ventilation during October and in the same period 50 tons of explosives were consumed. The 721 ft. of dolomite traversed had been pre-cementated; 103,000 pockets of cement, slag, and slime were injected in pre-cementation operations. No water was encountered during sinking. However, sinking in the dolomite was hampered by the interbedded shale layers and chert bands.

## Ore-Dressing Notes

### (18) *Handling.*

#### **New Belt Construction**

Now marketed in America is a new type of conveyor-belt for which it is claimed that the troughing idlers can be set at 45° through design which avoids the risk of ply separation at the hinge line between the centre roll and the steeply set side rolls. For a given width of belt greater carrying capacity would be assured with 45° troughing instead of the usual 20° and since a narrower belt thus gives this (claimed at 25% by the makers) initial cost is lower. A further claim is that since the major cause of wear is abrasion at loading point in an otherwise properly maintained belt increase of depth of load reduces the area of contact between the belt and that load. Centring of the load is also better with the steeper sides. The manufacturers warn that at this time the belt is not suitable for hot materials and that it must run at 400 ft. per min. or faster to give a suitable clearance trajectory at the discharge end.<sup>1</sup>

### (19) *Mill Water.*

#### **Conservation Practice**

Five of America's western States produce some 90% of the country's copper and although the area concerned is about 60% of the United States' land surface it receives only one-quarter of the total rainfall. Of this disproportionately low average only 30% is available for use, the balance being lost through evaporation. Agricultural users can and traditionally do go where the water is but miners must either work with local supplies or spend money on bringing it in from a distance. The question of availability thus is, as is noted in a paper by Michaelson, Ensign, and Hubbard (*Min. Engg.*, July, 1960), "... a controlling factor of copper production" in the semi-arid regions of America. Arizona produces 49% of the country's copper and has a rainfall averaging only 16.4 in. in the mining areas which must compete with the claims of agriculture and ranching. In terms of yield the best-paying farm crop is lettuce at \$4.52 per 1,000 gal., livestock returning 30 cents per 1,000 gal.; against this copper gives \$7.80.

<sup>1</sup> *Engg. Min. J.*, Oct., 1958.

The authors of the paper noticed here suggest therefore that national interests would best be served by the most productive use of raw material and that this should be made the criterion in the allocation of water. Some 40 gal. are needed to produce 1 lb. of blister copper and of this 1% is used in mining and 91% in milling the ore. The farmers could make a strong case against the proposed criterion since they might argue that minerals are wasting assets and farming (with ranching) a continuing activity but the figures are interesting.

Although modern pumping systems have made the technical problem of bringing distant water to the mill relatively simple, availability and cost of transport are limiting factors and are reflected both in the cut-off grade of ore mined and in the inter-dependent costing of the size of operation. Reclamation and re-use of process water is therefore of even livelier concern in the copper area than in most places. The simplest method of conservation makes use of return water from tailings ponds drawn *via* decantation towers. This, particularly where humidity is low, entails a high loss through evaporation which to-day is mitigated by filming water storages with cetyl alcohol. Judicious use of cyclones and thickeners on the plant effluent reduces the liquid content of the water sent to settling dams and, to that extent, the cost of this filming.

The limit of recycling of process water is reached when chemical change, hardness, or contamination of a type which would endanger the process go beyond a safe working limit. Reviewing practice at 13 major plants, the authors note that all of them practise some degree of water conservation while some take that work to the practicable limit. The ratio of reclaimed to new water varies from 1 to 1 up to 4 to 1.

Theoretically recovery and re-use could be complete but in practice the average technical and economic optimum is around 50%. To improve on this flotation middlings would need thickening before being returned to circuit, tailings would have to be slurried before running to waste, and disposal areas would have to be limited to leakproof strata. This, with the use of cetyl alcohol, would improve recycling to 67% and reduce the make-up water to 1 ton for each ton of ore treated. The authors do not discuss the question of pre-treatment by methods such as might upgrade run-of-mine ore while making a substantial rejection of waste.

We have to-day grown so accustomed to the application of flotation to low-grade disseminated ores that consideration of a scalping process on shaking tables rarely receives attention at the design stage, but this comment is made here without personal knowledge of the crystalline make-up of the ore complexes concerned and is rather put forward as a general suggestion to the testing laboratories. Pressure on available water is a fairly new problem of design but one which will grow with the increasing industrialization and growth of the world's population. Another passing suggestion is that the rising generation of miners may find it economically feasible to kill three birds with one tailings effluent by filling the hole the ore came from with evaporation-free underground reservoirs which will act as solid support and drain their water to pumps for re-use by the mill. This is already practised in part by some plants but the full use of hydraulic transport (both in and out of the mine) is yet to come.

Perhaps the most thought-provoking point made in the paper is that on purely statistical evidence water used in copper production gives 25 times the yield it could offer if directed to farming. Earlier it was suggested that this was an over-simplification but though the ore is a once-for-all crop the ore product continues in the service of humanity. The enormous losses through evaporation will not always be accepted as inevitable. Already we have seen in the Sahara the effect of topping up the underground reservoirs *via* a fault-zone from the snow-waters of the Atlas. In London the water table, steadily drawn down by artesian wells for decades, now shows signs of recovering thanks not to the recent disastrous summer but to increased action by the authorities concerned with such matters. Leaching *in situ* is to-day practised on copper ores too lean to warrant mining and transport. It can be asked if these are signs of change and whether the abandoned stopes of to-day may become the reservoirs of to-morrow.

## (20) Grinding.

### New Ideas in Automatic Control

Despite all advances in mill technology the most expensive single stage in treatment for most ores continues to be the wet grinding to a release mesh well below 60 mesh. Hence

the methods used in fine comminution and the ways in which their control can be improved are of abiding practical interest to the plant superintendent. The dominant factors which press upon his attention in this connexion are (a) the rising cost of treatment, (b) the steady lowering in grade of the ores treated, and (c) the tightening up of specifications in the product which is sold by the mill. Improved methods of mineral processing have to-day made it a simple matter to handle large tonnages at a small cost for the labour of a few trained shiftsmen. It would therefore seem at first sight hard to justify the installation of expensive and somewhat temperamental automatic aids to mill control. Experience shows, however, that the gain in item (c) above is felt right through an efficiently integrated flotation circuit when the grinding is truly steady and the sizing pattern of the released sands is consistent. This justifies the continuing search for simple and foolproof methods of automatic control. Many have been reported in these Notes but the search continues and is likely to do so for a long time yet.

The most readily seen variable when an individual grinding unit is swinging either toward overload or underload is the circulating sand returning from hydrocyclone or classifier and various methods of monitoring this have been put to work. They include such old favourites as observation of the depth of burial of the rakes, ammeter or load reading of the classifier motor, check of the pump load between mill discharge and bowl classifier, weighing of the cyclone underflow, use of bubble-pipes in the classifier pool, measurement of the sound level in the ball-mill, radioactive response, and change in the mill-discharge density.

Two of the newcomers to automatic control are described by N. Weiss in *World Mining* of San Francisco for June, 1960. The first of these—water balance—appeals by its simplicity. It starts its control by varying the feed water to the mill scoop box in such a way as to hold the mill discharge at a constant density level. A flow-meter measures the water thus added and signals changes to a pneumatic or magnetic transmitter. This in turn acts upon the rate of delivery of new ore. Thus, if the mill discharge density rises the feed-water rate is increased and at the same time the sensing device reduces the rate of new feed. This probably is done to the controlling rod-mill working in open circuit ahead of the ball-mill which has made the overload

signal, though it can obviously be applied to the ball-mill feed direct. If the mill discharge density falls feed water is reduced and the change is relayed to the ore feeding device, causing it to increase delivery rate.

This system, together with the one described next, is now being incorporated in a plant undergoing erection in Arizona. This second idea, called the "Delta-T," is operated by variance in the temperature change between feed water and mill discharge pulp. The input heat to the mill load is supplied by ore, feed water, any chemical reaction, and principally from the conversion of input grinding energy. The control is based on the assumption that the relation between power consumed and heat released in the pulp is fairly constant. As described by Weiss the temperature difference measured could be either that of the feed water or of entering pulp against mill discharge temperature. If, owing to the arrival of ore harder than usual to grind the circulating load through the mill rose while the heat input remained constant the discharge temperature would drop. This change could be caused to lower the rate of new feed as the control system is sensitive to a variation of  $0.1^{\circ}\text{F}$ . Though again very simple this system might run into difficulties with the ore-body which is to be treated, in which the density varies between 2.7 and 3.4. This would affect the solid/liquid ratio for a given pulp density and might perhaps introduce a variation in the specific heat with the change in composition of the ore. The experience which will be gained in operation of these novel methods should be of wide interest.

## Book Reviews

**A History of Platinum.** From the Earliest Times to the Eighteen-Eighties. By DONALD McDONALD. Price 35s. Cloth, large octavo, 254 pages, illustrated. London: Johnson, Matthey, and Co., Ltd.

In a style both elegant and precise the author surveys the story of platinum from its earliest occurrences through 150 years of scientific inquiry, diligently pursued all over Europe and as a rule unselfishly shared. When supplies from Spanish South America declined at the end of the eighteenth century

the new Russian fields soon provided a source from which all the scientific and industrial advances of the nineteenth century were fed. In these advances Percival Johnson and George Matthey played no small part, both as a research team in the field of chemical engineering and as men of business with acute industrial foresight.

The transaction whereby, in 1882, Johnson, Matthey and Co. took over the whole of the Imperial Russian stocks of platinum marks the beginning of the end of that era with which Mr. McDonald deals almost nostalgically. Henceforth platinum "moved from the laboratories of the scientists into the factories of the industrialists" attended by all the secrecy which commercial competition engendered. Its subsequent history may be written, but it will not be a labour of love, as was clearly this work, of which the format, illustrations, and bibliography leave nothing to be desired.

**Bergbaumechanik.** Lehrbuch für bergmännische Lehranstalten; Handbuch für den praktischen Bergbau. By MAERCKS—OSTERMANN. Fifth revised edition by W. OSTERMANN. Cloth, octavo, 612 pages, illustrated. Price DM36. Berlin: Springer Verlag.

This large heavy book (nearly 3 lb. in weight) of 612 pages, and containing 410 diagrams and 30 tables, is well produced. The printing is beautifully clear, the diagrams have been drawn with meticulous care, and the worked examples are admirably set out, the answers at once catching the eye. The book purports to be both a textbook for mining schools and a handbook for practical mining men. Actually it is a seemingly exhaustive treatise on applied mathematics, with particular reference to mechanization in mining.

The matter in the book is arranged under four main sections—statics of solid bodies, dynamics of solid bodies, strength of materials, mechanics of fluids—and these are subdivided into smaller sections numbered consecutively throughout, there being 140 such sub-divisions.

Undoubtedly the book is capable of serving the two objects for which it was written.

Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

## Engineering Log

Two or three years ago, when faced with a demand for fine-grained iron ore suitable for sintering the LKAB company, in northern Sweden, introduced a type of automatically vibrating screen which appears now to be successfully operating. In this screen, known as the L-screen, the decks consist of parallel transverse rows of round rods inserted in holes drilled in the sideplates and central beam of the sloping rectangular framework, the rods having a somewhat smaller diameter than the holes in the side frames so that they can move freely in their mountings when vibrated. At the feed end decks are placed on rubber buffers, while at the discharge end they are suspended so that the slope can be adjusted to suit the feed. Such screens introduced at Malmberget and Kiruna have proved superior to ordinary vibrating screens, operating economically and reducing blinding to a marked extent.<sup>1</sup>

\* \* \*

Industrial trucks for factory use are likely to change but little in the next few decades, design still being related to known factors such as pallet sizes. While rail and road transport are subject to modification one new mode of transport has to be considered and that is the "hovercraft." The prototype of this vehicle, which operates through a downward thrust of air to suspend and propel the craft must operate at low heights. It cannot pass over built-up areas, but cross-country paths could be cut and along them cruising speeds might be around 100 m.p.h. For built-up areas, overhead strips could be constructed to withstand the air thrust, with guiding beams and control points.

\* \* \*

A revolutionary new head-office building is to be built in Antwerp for BP Belgium. Rising to about 170 ft. in height, the building will have 12 main floors which will hang on steel cables. The main support of the building will be provided by a concrete central core formed by two lift shafts, concrete beams being cantilevered out from the top of this central core; from the beams the steel cables which will support the floors will be suspended. The use of this unusual method of construction will mean that the windows and floor space will be entirely uninterrupted by

structural supports, thus admitting the maximum amount of natural light and giving the greatest flexibility in the division of the office space. Over 400 people will work in the new BP Belgium head office, which is expected to be completed in 1962. The site is a prominent one in the fast developing new Van Ryswyck district at the entrance to the City of Antwerp. At this point it will be within easy access of Brussels and other important centres in Belgium.

\* \* \*

Speaking at a local meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers recently Dr. C. C. Long, research director, Zinc Smelting Division, of the St. Joseph Lead Company, said that "it had long been observed that there was a lower incidence of cancer among people occupationally exposed to lead than among the general population. A small but vital effort is being made to determine by means of culture tests the effects of organo-lead compounds on cancer tissue. Preliminary results reveal an inhibiting effect on the growth of cancer cells, but it is thought much too early to comment on the possible future role of the effect of lead on cancerous tumours.

\* \* \*

In a recent issue of the MAGAZINE reference was made, in the course of review of mining research in South Africa, to the preservation of mining timbers, particularly from the point of view of the disease *sporo-trichosis*. It has been pointed out by one firm interested in timber preservation that while treatment was initiated in South African mines as a means of economizing on mining timber, that aspect is now regarded as being of little importance compared with the prevention of disease. The great bulk of the timber treated is required to last for only three to five years and, since it is never recovered, there is no question of re-use. The exception, of course, is in the more permanent timbers in the main driveways and in timber used for packing and shaft sinking. In addition to the prevention of the outbreak of diseases caused by fungal spores preservation is regarded as important from a second point of view—namely, the reduction of the fire hazard. The preservative used is not a true flame retardant, but in common with many metallic salt preservatives, it has a small, but useful flame retardant effect. Since the required increase in service life is so small

<sup>1</sup> Engg. Min. J., July, 1960.

it is understandable that South African mining companies are not interested in a very high performance preservative but have adopted a cheaper and less permanent product. Treatment is carried out by vacuum-pressure impregnation, some of the mines owning and operating their own plants.

\* \* \*

Studies of the U.S. National Aeronautics and Space Administration's research centre in Langley Field, Virginia, have successfully demonstrated the effectiveness of a new "paraglider." Of extremely simple design, the glider consists of a flexible wing with rigid leading edges. A space capsule with an astronaut can be suspended below the glider. N.A.S.A. has been seeking a device light enough to use for slowing re-entry from space into earth's atmosphere without risk of burning up the space capsule from air friction and the paraglider appears to be the answer. In addition to lightness it has the advantage of being capable of compact folding, ready for use when needed. Research tests have proved that with the paraglider, maximum re-entry temperature can be held down to 1,500°F. If constructed of a non-porous material, such as aluminium, the paraglider will slow speed more effectively than a conventional parachute does at supersonic speeds. The parachute tends to develop a pumping action at these speeds, which bounces the cargo dangerously. This has been demonstrated by wind-tunnel tests. Several methods of packing and deploying the paraglider have been suggested and proved.<sup>1</sup>

### Recent Researches on Beryllium Ores

Explorations for beryllium ores are now occupying the attention of geological organizations in many countries, and a group of papers on prospecting methods presented at a recent meeting of the Institution of Mining and Metallurgy (1)<sup>2</sup> has stimulated much interest among British geologists. Concomitantly the United States Geological Survey has been active in similar studies, and in a recently published synopsis of the Survey's geological researches during the year ended June 1960 (2), many references are made to

beryllium investigations. It is stated that the supply of beryllium obtained from pegmatites throughout the world is so small that hope for any great increase in production rests mainly on the possibility of finding major beryllium deposits in non-pegmatite rocks.

#### *Beryllium in Volcanic Tuffs*

Noteworthy among the new types of beryllium deposit is an extensive field in the Thomas Range district, Juab County, Utah, discovered by prospectors in the spring of 1960 (2). The beryllium occurrences are in a rhyolitic tuff, which is part of a sequence of faulted and tilted Miocene volcanics, overlain by Pliocene volcanics and Quaternary lake beds. The only beryllium-bearing mineral thus far identified is bertrandite,  $\text{Be}_4(\text{OH})_2\text{Si}_2\text{O}_7$ , which occurs along with opal, montmorillonite, fluorite and calcite.

The bertrandite and associated minerals are most abundant in elliptical nodules that range from 0.5 to at least 8 in. in length. Five samples of the tuff from two of the occurrences were determined by beryllometer measurements to carry 0.25% to 1.5% BeO; nodules from these same tuffs contain 1.8% to 10.7% BeO. The beryllium-rich layers, which are not everywhere at the same horizon, may be several yards thick but contain erratically distributed barren areas. The bertrandite and rather abundant fluorite were apparently deposited in Pliocene time during the waning stages of the younger period of volcanism.

Exploration by mining companies has disclosed a number of localities, over an area of several square miles, where the tuff is mineralized. Because of the extensive distribution of this favoured bed, brought repeatedly to the surface by faulting, opportunities for further discoveries are thought to be promising and it is reported that the reserves of beryllium in the area could be very large.

#### *Bertrandite Greisens*

Bertrandite, which contains three times more beryllium than beryl, is apparently much more widespread in nature than commonly believed. In the Lake George beryllium district near Pikes Peak, Colorado, where beryl has lately been worked in quantity, bertrandite was found last year in mica-quartz greisen (3); and some of this bertrandite-bearing rock has proved to be richer in beryllium and considerably easier to mine than the beryl ore. In addition to quartz and muscovite, fluorite is present in

<sup>1</sup> *Science News Letter*, Sept. 17, 1960.

<sup>2</sup> A list of references is given at the end of this note.

almost all of the greisen and topaz is abundant locally. Various sulphides, wolframite and sooty pitchblende are also present, generally sparsely distributed but locally constituting several per cent. of the rock. Most of the beryl ore produced from the district has come from vein-like deposits in greisen, near contacts between granite and metamorphic rocks.

As the bertrandite is of inconspicuous appearance, closely resembling feldspar and stained quartz in the hand specimen, its abundance in these rocks was overlooked until electronic beryllium-detecting devices were employed. Somewhat similar deposits in Transbaikalia and the Altai are described in the latest Russian monograph on beryllium ores (4). These new discoveries lend weight to the suggestions already made by several writers that greisens in Tasmania, Nigeria and elsewhere all merit study as potential sources of beryllium.

#### *Beryllium in Tungsten Skarns*

Another large beryllium deposit was discovered late in 1959 at the Mount Wheeler tungsten mine, White Pine County, Nevada (5) where scheelite has been worked for some years from a silicified limestone intruded by quartz-monzonite and granodiorite. Commercial analyses of the tungsten concentrates revealed more beryllium than could be accounted for by the small quantity of beryl observed at the mine; and mineralogical studies by the U.S. Geological Survey then demonstrated that the beryllium in the ores is contained principally in the minerals phenacite ( $\text{Be}_2\text{SiO}_4$ ) and bertrandite. Since these are readily mistaken in the hand specimen for quartz, the deposit escaped the notice of the many geologists who had studied the tungsten ores.

The beryllium minerals are here intimately associated with scheelite, fluorite, pyrite, sericite and manganoan siderite. Pale-blue beryl forms veinlets and small isolated crystals. Between September, 1959, and March, 1960, about 600 ft. of new underground workings was opened up and 10,000 ft. of underground diamond drilling completed. The ore-shoots, along quartz veinlets following steeply dipping fault fissures in a 20 ft. thick limestone, range from a few feet to more than 10 ft. in width and from 15 ft. to 20 ft. vertically, and one shoot has been traced vertically for a strike length of about 1,500 ft. The average  $\text{BeO}$  content of the ore is about one per cent.

#### *Prospecting Methods*

Recent experience has shown that these non-pegmatitic beryllium ores are likely to be discovered only if geophysical or geochemical methods of prospecting are employed, since the pay minerals are not readily diagnosed in the hand specimen. The extent to which such techniques will be used by other than Government geologists will, however, inevitably depend upon a firmer long-term demand for beryllium than has hitherto been assured.

Foremost among these new tools is the electronic beryllium detector based upon a neutron : gamma reaction, a British example of which was described and demonstrated at the recent I.M.M. symposium (1). Different types of equipment are available for field and for laboratory use. In its annual report issued last month the Geological Survey of Great Britain notes that some 400 samples were assayed by beryllometer during 1959. Simultaneously an account has appeared of the comparable American equipment (6) employed in studying the deposits already referred to.

Again simultaneously with the British investigations studies in geochemical prospecting for beryllium have been undertaken by several research groups in the United States. For field use the U.S. Bureau of Mines (7) advocates a geochemical technique based on the fluorescence of a beryllium complex with morin. Spectrographic and fluorimetric analyses have been employed in prospecting work by the U.S. Geological Survey (8), whose report concludes that analysis of alluvium is an effective and economical way to find districts in which beryllium-rich rocks crop out. By this means it has been demonstrated that the tin regions of the Seward Peninsula, Alaska, contain interesting amounts of beryllium—as probably do many other tin and tungsten deposits also. In general any district should be considered favourable if it yields alluvial samples containing 10 p.p.m. or more of beryllium. Analyses of residual soils can be used to find individual bodies of beryllium-rich rock in the same way that float has long been used to locate mineral veins.

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## News Letters

### BRITISH COLUMBIA

November 3.

**Canadian Institute.**—The annual Western Meeting of the Canadian Institute of Mining and Metallurgy, held in Vancouver from October 17 to 19, recorded a registration of 567. Attendance at the general and technical sessions was unusually high, reflecting no doubt the optimism obtaining in the mining industry, particularly in western Canada and most notably in British Columbia. Possibly the greatest interest centred on the panel discussion on "Future Markets for Western Canadian Mineral Production." The moderator was Mr. A. O. Wolff, director of research and development of the Consolidated Mining and Smelting Co. of Canada, Ltd., and the panel members represented several producers or purchasers of Canadian minerals or metals. It is evident that British Columbia and Alberta are looking to Japan to provide a substantial market in the next 10 years for iron, copper, nickel, coal, and other products of their mines.

A second panel discussion concerned "What is Research Doing for the Future of Mining?" and was considerably more academic. For this the moderator was Mr. L. G. R. Crouch of the University of British Columbia, the panel members again including well-known men.

Two sessions were devoted to each of the following: Metal mining, geology, and metallurgy and one each to industrial minerals and coal mining. One of the metallurgical sessions discussed "Work Measurement" in the Province's leading metallurgical plants and the industrial minerals paper was closely associated with the booming construction industry of British Columbia. The coal mining session, under the chairmanship of Mr. D. B. Young, of Coleman, Alberta, took the form of a forum on "Mechanization of Pitching Seams." An excellent composite paper on "Current Operations at United Keno Hill" was presented by members of the operating staff of United Keno Hill Mines, Ltd., at a wind-up general session. Four excellent colour films, each depicting a different phase of exploration or development in both the mining and oil

industries, were shown at the first session of the meeting.

Appropriately, luncheons were sponsored on each of the three days successively by District No. 6 (British Columbia and Yukon), District No. 5 (Alberta and Northwest Territories), and District No. 4 (Saskatchewan, Manitoba, and North-western Ontario). At the first the speaker was Mr. H. A. McDiarmid, chairman of the B.C. Division of the Canadian Manufacturers Association, and the subject "Future Manufacturing in British Columbia"; at the second the Hon. R. W. Bonner, Attorney-General of British Columbia, on "The Approach of Trade and Industry in Relation to Mining in British Columbia"; and at the third, Dean H. Goard, assistant director of adult education for the Vancouver School Board, on "Future Patterns in Education." At the annual dinner Dr. G. N. Perry, Dean of Commerce at the University of British Columbia and recently a staff member of the World Bank, spoke on "Financing World Development." The observation of Attorney-General Bonner that the Canadian mining industry would be immensely strengthened if the Canadian dollar would settle to a more realistic value at 10% less than its United States counterpart was undoubtedly the opinion of all present if the volume of applause provides any indication.

Unfortunately, W. H. Durrell, of Montreal, president of the Institute, was unable to attend. In his place Dr. J. C. Sproule, immediate past president, assumed the presidential duties and distinguished himself with his performance. The head office was represented ably by C. Gerow, M.B.E., secretary-treasurer.

**Placer Development, Ltd.**—The consolidated net profit of Placer Development, Ltd., and its wholly-owned subsidiaries for the year ended April 30, 1960, was \$1,580,431. The consolidated unappropriated earned surplus now stands at \$18,681,363 with a shareholders' total equity of \$28,281,516 or \$10.96 per share.

At the annual meeting on October 18 Mr. John D. Simpson, the company's president, reported that the Jersey lead-zinc mine at Salmo was operating normally at 30,000 tons monthly. In the five months to September 30 (including a two-week vacation period) the mill treated 142,817 tons of ore grading 2.3% lead and 4.6% zinc. At the end of the period ore reserves were estimated at 635,565 tons grading 2% lead and 4.9% zinc. Marketing of output was disrupted by a strike at the Bunker Hill smelter which commenced May 5 and has not yet terminated. Other satisfactory arrangement was made for treatment of zinc concentrate, but lead concentrate has of necessity been stockpiled since August 1.

Exploration has been conducted actively by Canadian Exploration, Ltd., and its wholly-owned subsidiary Canex Aerial Exploration, Ltd., and also indirectly through participation with other companies. Placer's only current venture in the petroleum field is a 15% interest in a Crown reserve of 10,240 acres in the Foothills area of Alberta.

Plans are well advanced for early production at Craigmont Mines, Ltd., near Merritt. The latest estimate of indicated ore reserves is 22,241,000 tons grading 2.09% copper and 19.8% iron. Canadian Exploration, Ltd., now owns 36.5% of the common stock of Craigmont Mines and also holds a 50% interest in the operating agreement with the balance held by Noranda Mines, Ltd., and Peerless Oil and Gas Co.

Through Canadian Exploration, Placer has a 22.2% interest in Mattagami Lake Mines, Ltd., which is preparing a zinc-copper property for early production in northern Quebec. This property will be equipped with a smelter.

American Exploration and Mining, a wholly-owned subsidiary, is continuing its active exploration programme. During the five-month period since the close of the fiscal year properties have been examined in Alaska, Arizona, California, Colorado, Montana, Nevada, Utah, and Wyoming. Agreement has been reached whereby a Japanese company will perform substantial additional drilling and underground development of the copper property on Marinduque Island in the Philippines. Drilling is in progress in Alaska in a joint venture with another mining company on a nickel-copper prospect. An option has been granted to a responsible company for the purchase of limestone deposits in California. American Exploration has undertaken to conduct further exploration and if results warrant to develop to production the Silver Butte property in Montana. The last-named property has been developed to date by Vancouver interests.

The Evan Jones Coal Co., operating a strip coal mine near Anchorage, Alaska, has paid dividends of \$43,500 since April 30. American Exploration holds a 48.1% interest in the Evan Jones company which has military contracts for the delivery of 128,384 tons of coal by June 30, 1961.

Again through its subsidiary, Canadian Exploration, Ltd., Placer created yet another subsidiary in Australia, Wollecliff Pty., Ltd., which purchased all the shares of the S. and M. Fox group of companies for approximately \$4,300,000. The Fox group is engaged in metal mining, manufacturing, and transportation and earnings are expected to contribute materially to future consolidated income. Also in Australia the construction of a washery at the South Clifton colliery has been completed and an improved output is now being exported, while Placer has purchased a 95% interest in Excelsior Collieries and Coke Works, Ltd.

## EASTERN CANADA

November 21.

**Ontario Gold Output.**—In September the producing gold mines of Ontario milled 772,984 tons of ore and recovered 208,019 oz. of gold and 29,251 oz. of silver, valued at \$7,114,785. The Provincial Department of Mines "Gold Bulletin" for September states that for the first nine months of the current year 31 producing gold mines reported milling 6,964,249 tons of ore, which yielded 1,978,796 oz. of gold and 326,733 oz. of silver, with a total value of \$67,253,872. It is noted that Kirkland Minerals Corporation, Ltd., only operated their mill on a clean-up basis, while H. G. Young Mines, Ltd., reported their first production. In the same period of 1959 30 mines reported milling 6,884,256 tons of ore, yielding 1,957,987 oz. of gold and 289,798 oz. of silver, with a total value of \$66,280,990.

**Porcupine.**—An 800-ton a day mill is in course of construction for Kam-Kotia Porcupine Mines at its Copper property 24 miles west of Timmins. Equipment and material are at the site and it is hoped that production will start in February next. The proved ore reserves are given as 1,090,000 tons grading

1.725% copper above the 190-ft. level. It is planned to ship concentrates to the Noranda smelter and later to recover the zinc in the ore in a mill extension. Kam-Kotia is controlled by Viola-Mac Mines, Ltd., recently acquired by New Dickensan Mines, Ltd.

**Cobalt.**—After 53 years of operation the Silver-cobalt smelter operated by Deloro Smelting and Refining near Marmora is to close down. This is likely to affect those other local producers who will have to find a new outlet for their ores. The plant started its clean-up run about the middle of September, but shipments en route to the smelter before midnight October 15 were the last accepted for treatment. Closing of the smelter does not affect Deloro's stellite and precision costing division at Belleville.

The mine of the Bethlehem Steel Company, also near Marmora, has also closed down temporarily owing to a decline in the demand for steel. The operating company—Marmoraton—has an open-pit mine and turns out about 500,000 tons of iron pellets per year on a yearly basis.

**Sudbury.**—The interim report of the International Nickel Co. of Canada and its subsidiaries for the nine months ended September 30 shows net earnings in terms of U.S. currency of \$62,685,000 after all charges, depreciation, depletion, taxes, etc. For the first nine months of 1959 net earnings were \$58,222,000. Sales, cost of sales, and inventories continue to reflect augmented nickel supplies acquired at market prices in connexion with reduction of United States procurement contract obligations, the report states. Capital expenditures for the nine months were \$55,892,000 and for the full year 1960 they are estimated at about \$75,000,000. In a letter to shareholders it is stated that the new nickel project at Thompson, Manitoba, begun in December, 1956, is now rapidly nearing completion. Thompson is scheduled to begin commercial operation in early 1961 and will have an annual capacity of at least 75,000,000 lb. of nickel, "making it the second largest nickel-producing operation in the world." Thompson will raise Inco's total nickel production capacity to more than 385,000,000 lb. per year and the new metal, it is suggested, is an indication of the "company's faith in the growing industrial economies of the free world."

**Manitouwadge.**—In the nine months to September 30 last Geco Mines milled 999,651 tons of ore for an estimated net profit after provision for depreciation and pre-production expenditure write-offs of \$1,457,000 and all taxes of \$4,383,000. The company's exemption from Federal income tax ended on September 30. Underground development is proceeding satisfactorily, it is stated, while ore is being extracted according to a systematic plan calling for an increased tonnage from the "B" orebody, which is lower in copper than either "A" or "C."

**Manitoba.**—The Chisel Lake property of the Hudson Bay Mining and Smelting Company came into production in September. Ore with a content of 1% lead and 11% zinc and low values in copper and silver is being extracted at 1,400 tons a day. The company states that the daily tonnage at the Flin Flon mine is to be decreased by the amount that comes out of Chisel Lake. Production from other mines—such as Coronation and Schist Lake—provide a total of 2,100 tons a day and the company's treatment plant tonnage is about 4,600 tons. All this will give Flin Flon an 11 to 12 year life extension

It is expected now that Hudson Bay will cut down its copper output and increase zinc production.

**Quebec.**—At Mattagami Lake Mines the new 6-compartment shaft is expected to be completed to the 1,200-ft. level in the current month. Stations have been established at the 150-, 350-, 550-, and 750-ft. levels and lateral work will follow immediately after completion of sinking. The mine is expected to be in production by the autumn of 1962 and the mill will have a minimum capacity of 2,000 tons per day. Copper concentrates are to be shipped to the Noranda smelter. Meanwhile the all-weather road is more than half completed and will be finished in the spring of 1961. The Canadian National Railways have also started the preliminary surveys on the construction of a line from the Beattyville-Chibougamau line to the camp. The railway line is expected to be completed by the end of 1962.

## AUSTRALIA

November 21.

**Iron Ore.**—The questions of the reserves of iron ore and its export from Australia are now prominent. Western Australia is pressing for the removal or modification of the embargo on export imposed about 20 years ago. That State has a number of iron occurrences which it is anxious to turn to account by overseas sales but hitherto the Commonwealth Government has refused to permit export. A re-assessment of the reserve position has shown a substantial increase in the tonnage of ore of 60% grade and over that can be regarded as proved, with, in addition, an important tonnage of potential ore of lower but at present indefinite grade. Prospecting in Northern Australia has indicated what may be an important occurrence and a recent discovery of limonite in the south-west of Western Australia variously estimated to contain between 95,000,000 tons and 200,000,000 tons has stimulated the State's hopes for permission to export ore. While the south-western deposit at Augusta is large, insufficient work has yet been done to permit sound assessment of tonnage or grade. Although the potential tonnage of ore of economic grade in Australia has greatly appreciated so has the Australian demand for steel which the vigorous efforts and heavy expenditure on expansion by Broken Hill Proprietary have been unable to overtake.

Tasmania is still hopeful of establishing a State-owned iron and steel industry and is continuing prospecting work on the Savage River iron-ore deposits. Tentative assessments have suggested a tonnage approaching 200,000,000 with an average grade of 40% to 45% Fe. Such ore would need upgrading for economic smelting. It is considered that two years' work is necessary before the potential of this iron-ore deposit can be reasonably assessed.

Broken Hill Proprietary is preparing to increase output from the Iron Baron deposit in the Middleback Ranges, South Australia, and this deposit will be an important factor in the steel enterprise to be commenced at Whyalla.

**Uranium.**—Although a stage of stability appeared to have been reached in uranium mining there is prospect of a renewal of activity. Authorities have stated that the industry in Australia is safe until 1965 as the operating companies have long-term contracts and the rate of production has been

less than had been anticipated. After present contracts have been completed there will be a period of uncertainty until the early 70's.

The Bureau of Mineral Resources is to make an air-borne scintillometer survey of the Mount Isa district. The search is to be made at a flying altitude of 200 ft. along lines  $\frac{1}{2}$  mile apart. This work will be combined with aerial photography and the photographs showing preliminary results will be displayed at the Mining Warden's office at Mount Isa. This early work is to be supplemented as the survey proceeds and it is expected that this early release of information will lead to activity amongst prospectors. In this rugged country the accurate indication of the position of anomalies will be of great assistance and obviate much loss of time.

Mining at Rum Jungle, Northern Territory, which ceased on the working out of the ore-bodies by open-cut and the stockpiling of the ore for treatment, which work is still in progress, may be resumed. The operating company, Territory Enterprises, Ltd., which is working the deposit for the Commonwealth Government has called for tenders for the working of a new open-cut south of the present mine. This is considered to show that another ore-body has been found, but a decision to go ahead with the big excavation will not be made until tenders have been received and considered.

**Copper.**—The copper industry is raising two points of interest. Export of copper ore and concentrates, largely to Japan, is undoubtedly finding employment for a substantial number of men in North Queensland and to a lesser extent in the Northern Territory and Western Australia. This export outlet, together with the operations of the copper refinery at Townsville, where Mount Isa blister is being refined and from which port large shipments of concentrates are being made, is having a serious effect, however, upon smelting and refining operations at Port Kembla. Trades unions are becoming concerned over the employment position there and a deputation to the Australian Trade Minister contended that the export of concentrates that otherwise would have been treated at the Port Kembla works is threatening the employment of 10,000 men.

There is also anxiety over the future policy of the Commonwealth Government with regard to the copper industry and the bounty position. Mount Morgan looks on a clear statement of the bounty position as most important and it is hoped that the decision will not be less favourable than was the position last year, when the higher average price for copper, £A315, with the addition of the bounty were mainly responsible for the profit of £A425,712. Mount Morgan suffered a severe disappointment to its hopes for utilization of its pyrite concentrate in the decision of U.S.A. interests to join with the company in the establishment of an ammonium sulphate industry based on Mount Morgan pyrite. With the ready availability of sulphur Australian manufacturers of sulphuric acid for the superphosphate industry are not attracted to the use of pyrite and the lack of a bounty to encourage its use has reduced pyrite sales and imposed a heavy handicap on producers of sulphide ores.

**Gold.**—A case has been presented to the Commonwealth Government for greater assistance to the gold-mining industry. A request was also made by the Amalgamated Prospectors and Leaseholders Association in Western Australia for a review of the subsidy on gold production as affecting the small

producers particularly. The cut-off limit of production for subsidy by these producers is 500 fine oz. of gold per year and the request is that the subsidy be paid on the first 500 oz. regardless of annual production and that the limit should be raised to 2,000 oz. per year. It was contended in the application that an amendment on these lines would encourage prospecting and increase the production of gold but the request has been refused by the Federal Treasurer. Despite lack of encouragement from the price of gold there has been a marked increase in interest in gold prospecting and a number of small high-grade crushings have been reported in recent months. A new producer in the company class has commenced work, North-West Mining N.L., at Nullagine, having re-opened the Blue Spec mine which has been idle for some years. The first run by the new company recovered 455 fine oz. of gold from the treatment of 700 short tons of ore. The Blue Spec deposits is one on a mineralized line about 12 miles long and it is a field that warrants attention.

## FAR EAST

November 15.

**Malayan Tin Industry.**—Malaya's position as the world's largest tin-producing country may be seriously threatened through "a grave shortage of workable land," according to Mr. K. J. Cumming, presiding at the annual meetings of Austral Malay Tin, Ltd., and its associates. Referring to the recommendations of the Land Administration Commission, he said little had been done to implement them although both the Federal and the State Governments had been reminded of the need to formulate a sound and realistic land alienation policy. He thought more land should be made available for prospecting, since because of the recent suspension of export control some countries might find it difficult, if not impossible, to maintain past outputs.

The *Straits Times* has also recently stressed danger to the industry unless new land is made available, output will fall, and the metal price will rise to kill the market. It has been said that "danger already threatens, as miners who closed down in the lean years forbear to reopen while they weigh the advantages of moving their capital into other industries—and perhaps other countries. Several large companies are drawing close to the end of their reserves . . . Greatly increased prospecting is the first necessity, certainly. Licences ought to cover substantial areas of land, say 10 times what might constitute an economic mining lease. Prospecting permits, which carry no guarantee of a mining title, should fall into disuse, just as they long since fell into disrepute." In response to this Mr. J. B. Melford, Commissioner of Lands and Mines, Pahang State, has said that in Pahang since January, 1960, more than 250 applications for prospecting permits and licences "have been dealt with. The majority were approved. The average area permit or licence is approximately 2,000 acres."

**Iron-Ore Production.**—During the first nine months of 1960 the Federation of Malaya produced 4,286,315 tons of iron ore, 525,631 tons more than the total (3,760,684 tons) for the whole of 1959. The rising fortune of the iron-mining industry in Malaya provided employment for nearly 2,000 extra

workers in the period of 1960 under review. There were now some 6,200 people employed at the 21 iron mines in Malaya. Malayan iron-ore miners signed contracts with Japanese steel companies to export a total of 4,750,000 tons of ore to Japan in the current fiscal year which will end in March, 1961. A delegation of Japanese steel industrialists, recently in Malaya to investigate the iron-ore industry, has suggested that the Government should build more roads to the mining deposits and encourage more investments. Japan is prepared to buy considerably more iron ore from Malaya provided the quality and the price were satisfactory.

## SOUTHERN AFRICA

November 30.

**Uranium.**—At the time of writing discussions are in progress between representatives of the United States and British Combined Development Agency headed by Mr. Jesse Johnson and Sir A. Hitchman on the one hand and the S.A. Atomic Energy Board on the other on the contractual sales of uranium oxide. The talks are proceeding against a background of speculation whether the contracts will be spun out beyond the present terms which will expire over the 1963-67 period or whether the terms will stand as they are. There is also speculation whether those companies the uranium earnings of which are relatively small compared with gold income will at least temporarily suspend uranium production at sometime in the future in favour of those mines the revenue of which is largely or almost completely dependent on uranium. The aggregate tonnage of contractual sales is presently 6,200 tons of uranium oxide a year. The mines most dependent on uranium production are Afrikaner Lease, Daggafontein, Welkom, Luipaards Vlei, Vogelstruisbult, Virginia, Freddie Consolidated, Randfontein, East Champ, Dominion Reefs, and West Rand Consolidated. Harmony by reason of its quantitative output and Lorraine without its Elsburg Reefs could be classified with the foregoing companies. Western Reefs, President Steyn, and Doornfontein are mines which would be seriously affected were their gold grade to decline appreciably. Vaal Reefs, President Brand, Blyvooruitzicht, West Driefontein, Hartbeestfontein, Buffelsfontein, and Stilfontein are relatively high-grade gold producers, which could and are probably providing or have provided for stepping up gold production against the possibility of a suspension or decline in uranium earnings. In the 1959-60 year the Harmony mine contributed nearly 6.5% to the total uranium sales and the mine's working profit therefrom amounted to 44.5% approximately of its total working profit. Without any adjustment to its gold grade the Harmony mine would appear to be able to offset total loss of its uranium income only to the extent of about 50% or so by expanding milling another 50,000 tons or so a month. It has two uranium contracts—one with the Combined Development Agency amounting to about 245 tons a year and another with the United Kingdom authorities averaging a maximum of 200 tons a year in the 6½ years from mid-1960 to the end of 1966.

**Mine Labour.**—The native labour returns, despite the slight average decline in the gold-mine members' complement in 1960 from 1959, show that the industry's requirements, particularly when set

against the progressive extension of mechanization on surface as well as underground, have been fully satisfied. The same condition has more recently applied to the colliery members, with the exception that the pattern has been less uniform than in the gold section. In the colliery section mechanization is also being progressively extended.

Recruiting of white personnel for the training schools on the gold mines reflected an increase in the domestic figures but a considerable decline in the overseas numbers over 1959. In that year 1,776 South African and 162 overseas recruits entered the schools respectively as compared with 885 and 268 in 1958. Trainees in the schools who completed their indentures in 1959 numbered 231 South Africans and 272 overseas recruits, against 209 and 429 respectively in 1958. At the end of 1959 there were 1,376 South African and 297 overseas recruits in the schools against 689 and 473, respectively, at the end of 1958. Winding-engine driver trainees increased in 1959 to a daily average of 80 in 1959 from 46 in 1958, while 74 qualified against 48 in 1958. Recruiting of learner officials (mining) has been continued by the Chamber for the groups, which are now solely responsible for their subsequent training and for the provision of university studies. Enrolment in the early part of the year was below requirements, but a considerable improvement was recorded in the closing stages of the year. To stimulate recruitment of learner officials (mechanical and electrical engineering) and raise the standard of training the gold section late in 1959 introduced a four-year training scheme for matriculants which provides for education on the mines as well as 4½ months full-time attendance each year at the technical college.

In addition, the gold committee has agreed in principle to higher rates of pay to officials who hold certificates other than those required for their particular occupations and suitable additional benefits have, it is understood, been granted. Underground native controllers were granted increased pay rates from the beginning of 1960.

The minimum salary schedule for surface officials is being reviewed, but the gold committee has not found it possible to agree to any system of control or to any static arrangement over the creation of new designations for such officials. A text-book for the training of mine clerks is being prepared, on the completion of which the introduction of a course for a certificate in mine clerical work will be considered. The Association of Mine Clerical Employees of South Africa was amalgamated with the Mine Surface Officials' Association of S.A. with effect from July 1, 1959.

**Mine Finance.**—While the Chamber of Mines has been unable to report any amendment of the scale of taxation it has been able to refer to the extension of the special allowance for deep-level operations. Nevertheless, it has made representations to the Government for the removal of discriminatory taxation on gold and uranium. Such taxation was originally imposed when gold mining was virtually the only large-scale industry in the country and stemmed from budgetary expediency based on the concept that gold deposits are a wasting asset and that therefore a higher rate was justified to provide against the day when the gold deposits became exhausted. Conditions have changed, especially since 1946; the gold industry no longer holds the same critical position in respect of providing direct revenue and the excuse of budgetary expediency

is no longer justified. It is pointed out that increasing difficulties are being experienced in raising capital for new mines, aggravated by rising working costs and the fixed gold price. A new mine requires capital four to five times greater than pre-war levels and exploration for and development of a new mine extends over a period of 10 or more years. New mines should continue to be established and in the interests of the country's economy, capital should be found for this purpose. Projects to-day are stagnating which 10 years ago would have developed into new mines. The Chamber's views on uranium taxation are the same as for gold operations. Since contracts for uranium sales will begin to expire from 1963 the tax problem becomes more acute for reasons of competitive conditions. A gradual readjustment of gold-mining taxation to levels applied to other industries is urged by the Chamber.

**Research.**—The research programme of the Chamber of Mines continues to expand. Interesting points in the current programme include the study of bacteria which are believed materially to enhance uranium leaching; pure cultures of two types have been produced in the laboratory and experiments have been started to test their efficacy relative to the leaching of low-grade uranium ores. The electron microscope has revealed the presence in underground dust of many particles below the present limit of visibility of the light microscope. It is not yet known whether or not these particles present a health hazard.

**Trade.**—In the first nine months of 1960 and 1959 imports were respectively valued at £423,331,000 and £361,671,000 and exports respectively £332,685,000 and £310,015,000, excluding gold sales, which were respectively valued at £211,967,000 and £180,300,000. The increase in the latter is partly ascribed to private sales. In the two periods mentioned the South African gold output amounted to 15,982,419 oz. and 14,894,979 fine oz. The indications are that in the 1960 period at any rate gold sales were well up to production.

**Transvaal.**—Hartebeestfontein Gold Mining, which milled 118,000 tons in October, expects that the milling rate will be advanced further to 130,000 tons monthly in the first half of 1961. In the uranium plant conversion to a high temperature ferric leach process has been completed and improved extraction and lower treatment costs are expected to be derived from the modification towards the end of 1960.

The projected new No. 2 Shaft of Doornfontein Gold Mining, to be sited in the central section, will be 26 ft. lined diameter and equipped to hoist men, materials, and rock. The scheduled start of sinking is November, 1961, with completion and commissioning expected to be effected in December, 1965. It will serve to replace the Annon Shaft in the north-eastern section as that becomes exhausted, provide ventilation for extended operations, and facilitate exploration in the expectedly lower-grade western section.

The current programme of expansion at West Driefontein aims at a milling rate of 205,000 tons a month by July, 1964, of which 130,000 will be Carbon Leader ore and the balance Ventersdorp Contact Reef ore. Milling of the latter ore is expected to reach 50,000 tons a month by July, 1961, and 75,000 tons in the 1963-64 year. Milling of Carbon Leader ore has reached and is being maintained at 130,000 tons a month, the October yield being 18·695 dwt. a ton.

At Blyvooruitzicht Gold Mining sinking the four sub-incline shafts down to respective depths of 3,976 ft., 4,528 ft., 4,573 ft., and 4,132 ft. below 6 Level has been virtually completed and preparatory work on the sinking of a series of deep-level sub-incline shafts down to the southern boundary of the mine will be put in hand over the current year.

Johannesburg Consolidated has formed a syndicate to finance operations in another prospect on the West Rand—namely, Western Areas No. 2 Prospect. All the participants have not been disclosed at the moment but one is the J.C.I. company itself and another West Witwatersrand Areas, Ltd.

New Witwatersrand Gold Exploration is another company which is participating in the combined programme of exploring about 123,840 claims west of and between Klerksdorp and Wolmaranstad in the Western Transvaal. Other major participants are Consolidated Gold Fields of South Africa, the Anglo American Corporation, and Dominion Reefs (Klerksdorp), Ltd. The programme will extend over the next two to three years. Two drills are presently being operated.

New Witwatersrand Gold Exploration and Lydenburg Gold Farms are also participating in a combined exploratory programme over about 83,078 claims in the Brits and Rustenburg areas to the west of Pretoria. A major participant is Gold Fields

Finance Co. (S.A.), Ltd. One bore-hole is at present being drilled.

West Witwatersrand Areas reports, as has already been indicated in previous notes, on the possible extensions as inliers and outliers of the Witwatersrand sector of the great gold-bearing basin of the Transvaal and Free State goldfields. With the closer delimitation of the Witwatersrand system in recent years it has become increasingly apparent that greater attention should be devoted to possible extensions both lateral and in depth of the known sectors of the reef horizons which have been proved payable by exploitation in existing mines. This, the report states, is particularly true in the case of the West Wits. line.

Buffelsfontein Gold Mining has applied for the incorporation within its lease of 546 claims contiguous with its western boundary, which claims form the southern extension of 437 claims that will be incorporated within the Hartebeestfontein lease area.

**Orange Free State.**—Glitter has been disclosed in the south-eastern section of the lease area of President Steyn, where there has been a void in the knowledge of what values could be expected. About 8,500 ft. to the south of No. 2 Shaft a bore-hole has yielded values of 629 and 605 in.-dwt. at a Basal Reef depth of 6,703 ft. A second deflection is being made.

## Trade

## Notes

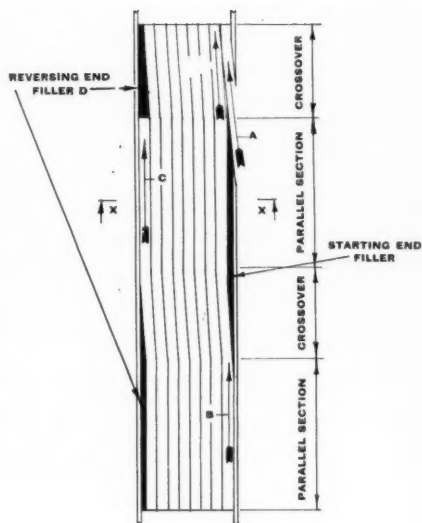
Brief descriptions of  
developments of  
interest to the  
mining engineer

### Multi-Layer Rope Spooling

Attention is called in an illustrated booklet recently available in this country to the LeBus system of controlled multi-layer steel wire rope or line spooling developed by LeBus International Engineers Inc., of Longview, Texas, for oilwell drilling operations and now widely known throughout the world. Applications of the system have been extended to cover many other equipments using steel wire rope and these are particularly the subject of the booklet referred to.

The illustration shows diagrammatically the development of a winch drum with the rope entry through one of the flanges at A. The drum barrel is grooved parallel to the flanges with two cross-over sections diametrically opposed. These, in conjunction

with positive control at the flanges, form a bed for the pattern which will fill the drum from flange to flange however many layers are booked. The grooving is continuous and parallel to the drum flanges except for the two cross-over sections, where the grooves move on half a pitch—i.e., one half of the rope diameter in the length of the cross-over. Hence, in one revolution the groove moves over two half pitches or one rope diameter. Consequently, as the position of each coil on the first layer is controlled and the formation of the second and subsequent layers are themselves controlled by the first layer the cross-over of each succeeding layer will always occur at the same point of the periphery of the drum. However many layers are booked, the drum will always build up on a pyramidal pattern and the



forces exerted by the rope coils on underlying layers will always be distributed in the same manner irrespective of the number of layers.

The booklet is issued by **Woodfield Rochester, Ltd.**, of 147 Victoria Street, London, S.W. 1, who are the technical representatives and sole representatives in the United Kingdom and the British Commonwealth (except Canada) for the system.

### Ladder Drilling

The use of the lightweight rock-drill together with a pneumatic pusher or airleg as developed in Sweden some 12 years ago has in the end been enthusiastically adopted all over the world, radically increasing drilling speeds and efficiency and resulting in considerable reductions in the cost of certain underground operations. However, over the past year or so efforts have been made in the same country to develop a system capable of drilling larger rounds with greater accuracy but using a reduced crew. As a result "ladder-drilling" has now been introduced and by it each man in the drilling crew can operate two or more machines although with reduced effort.

The main feature of the new method developed by **Atlas Copco AB**, of Stockholm, in conjunction with Swedish contractors and the Swedish State Power Board, is that

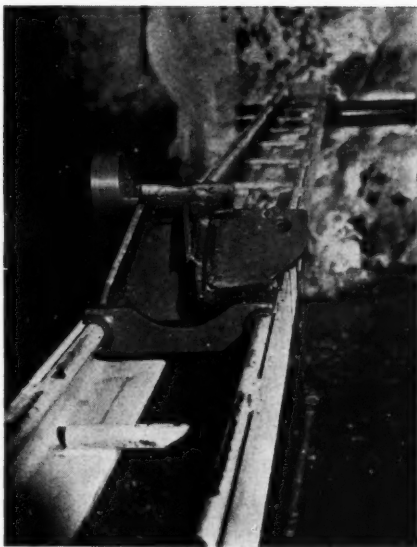


Fig. 1.—Drill Cradle on Loader

a rock-drill with retractable pusher-leg, is placed on a cradle (Fig. 1) sliding on a ladder, which is generally made of angle iron, the drill and the pusher being thus always "in line". When moving forward, the foot of the pusher kicks off from the rungs of the ladder and,



Fig. 2.—Rod Support

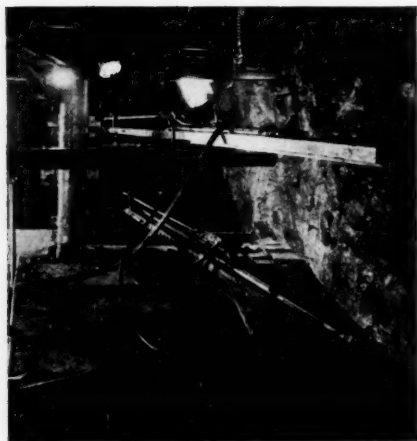


Fig. 3.—Two-Drill Set-up

when the piston of the pusher has bottomed, all that the operator has to do is to squeeze

a trigger on the drill to make the piston move quickly forward again to get a new grip with the foot of the piston rod. The steel, which may be 1-in. hexagon Coromant with tungsten carbide insert, is guided by a drillsteel support to facilitate collaring (Fig. 2).

The drillsteel guide and the pusher feed "in line" make longer drill-rod changes possible, an additional advantage of the method. It becomes possible, for example, to use only two rods to complete an 18-ft. hole. When the steel has been drilled to full depth the lugs on the top side of the piston foot can grip on the ladder rungs, so that the retraction power of the pusher can be utilized to extract the steel from the hole.

The main features of the method are, it is suggested: First, that collaring and hole direction can be made accurate for long rounds; secondly, that each man can operate more than one rock-drill; thirdly, that the method gives great flexibility and results in savings in time and effort.

## Personal

T. Q. ANNAN is home from Egypt.

G. P. BENNETT is now in South Africa.

R. L. BLANDY has left for Sierra Leone.

E. S. EVERITT has been elected to the board of directors of the Bucyrus-Erie Company of South Milwaukee, Wisconsin. Mr. Everitt is managing director of Ruston-Bucyrus, Ltd., Lincoln.

Sir PERCY HUNTING, chairman of the Hunting Group of companies, is retiring from the end of the year. He will be succeeded by his brother, Mr. G. L. HUNTING, the present vice-chairman.

R. A. MUDD has been appointed general manager of Bancroft Mines, Ltd., as successor to the late Mr. A. J. BRINK.

P. T. STEPHENS has been appointed deputy chairman of the Saunders Valve Company, while remaining joint managing director with Mr. A. L. TRUMP.

## THE INSTITUTION OF MINING AND METALLURGY

### Elections and Transfers

*Member.*—Ralph Augustus GORGES, B.Sc. (Camborne); Oscar Hammond SENIOR, B.Eng. (Canterbury).

*Associate Member to Member.*—George Edmund Arthur BANFIELD, A.R.S.M., B.Sc. (Que Que); George Andrew BEATTIE, B.E. (N.S.N.); Eric Charles BROMWICH, A.R.S.M., B.Sc. (Luanshya); Anthony William BURNE, A.C.S.M. (Kuala Lumpur); Irving Ross COREY, B.E. (Avoca); HERBERT DALTON-BROWN, A.R.S.M. (Sungei Besi); William Thomas DUNNE, B.Sc., B.E. (Kuala Lumpur); John Aislabie HILL, A.R.S.M., B.Sc. (Luanshya); Dean Arthur Oliver MORGAN, A.R.S.M. Ph.D. (London); Andries Hendrik TAUTE, M.Sc. (Groefontein).

*Associate Member.*—Alan Irwin BATTAGLENE, B.E. (Broken Hill); David Thomas BUCHANAN, Dip S.A.S.M. (Mt. Isa); Mary Sheila DEANE, A.B. (London); Alan Roy DRYSDALL, Ph.D. (Lusaka); David Anthony EVEREST, Ph.D., F.R.I.C. (Teddington); Alan GRIERSON, B.Sc. (London); Keith Frank HUSKISSON, B.Sc. (Kitwe); George Richard JACKSON, B.Sc. (Kitwe); Ian Brandt MARX, B.Sc. (Mashaba, S. Rhodesia); Alfred Lewis MATHER, Ph.D., D.I.C. (Accra); William Douglas PROCTOR, B.Sc. (Kuala Lumpur); Roy Gilbert SEAL, B.Sc. (Mbarara, Uganda); Michael George STONER, A.C.S.M. (Elliot Lake); John Frederick Cecil WHITE, A.R.S.M., B.Sc. (Casapalca, Peru); Abel WIGHTMAN, Ph.D. (Mufulira).

*Affiliate or Student to Associate Member.*—John Leslie BLACK, B.E. (Kitwe); Robert Hugh Lindley EGERTON, B.Sc. (Skouriotissa); David William HANNAFORD, B.Sc. (Konongo); Roland Harry LAMB (Kalahushi); John Peter REEKS, A.C.S.M. (Maracaibo); Henry Neville RHODEN, A.R.S.M., Ph.D. (Melilla, Spain); Michael John WEST, A.R.S.M., B.Sc. (London); Michael Edward WOAKES, A.R.S.M., B.Sc. (Mufulira).

*Affiliate.*—Ian Leslie Cambell GIBB (Jos); Douglas Hugh MASON-JONES (Kuala Lumpur); Nicos MICHAELIDES (Nicosia); Roy Hubert MOTT (Barakin Ladi); John Frank SPARKS (Sungei Lembing); Joseph Peris Wynn WILLIAMS (Camborne);

*Student.*—Terence Charles ADAMS (Birmingham); Jose Filomono Teixeira AGAPITO (Camborne); Jeffrey Robert BENNETT (London); Evan Roy BIGGS, B.Sc. (Entebbe); Christopher Patrick BRETT (Camborne); Gerald Edward COLE (Leeds); John David FAIRFIELD (London); Lionel Michael FALCON B.Sc. (London); Charles George MAXWELL FREEMAN (London); John Kenneth FROGGATT (London); Neville FIVAZ (Nkana); John Blundell GAMMON (Leicester); Kevin John GAHAN (Camborne); John Carlos Tobias GRIBBLE (Camborne); Inuwa Gombe (Camborne); John HAINES (Camborne);

Frederick Eldred St. George HALTON (London); James HOWCROFT (London); Hervey Vivian Christopher HOWELL (London); John Francis HUGHES (Birmingham); Roger Meager HUMBERSTONE (Camborne); Edward Mervyn William JONES (Camborne); Henry Selman KALIL (Camborne); Alan Cochrane KENNEDY (Birmingham); Paul du Plessis KRUGER, B.Sc. (Orkney, Transvaal); Douglas Andrew LAWSON (London); Rilwanu LUKMAN (London); Michael Hugh MADDOCKS (Truro); Hugh MAKINSON (London); Roger William PARROT (London); Hugh Trevor PORRITT (London); Dermot Macaragh ROSS-BROWN (Birmingham); Ying Yuen Soo (London); Iqbal SINGH (Camborne); John STEWARD, B.Sc. (Chester-le-Street); Roland STOCKTON (Germiston); Andres Zoltan SZERI, B.Sc. (Leeds); John Jefferson THOMPSON (London); Keith Henry THOMPSON (London); Anthony Peter TRAVIS (London); Brian TURNER (Birmingham); David Frank WATKINS (London); Christopher George WHITE (London); Paul Jonathan WHITE, B.Sc. (Leeds); John Duncan WILKINS (Camborne); John Michael WILLSON (London); Keith WILSON (Sheffield); Keith Geoffrey WOODS (Birmingham); Ian Percival Youles, A.R.S.M., B.Sc. (Macalder-Nyanza).

## Metal Markets

### During November<sup>1</sup>

**Copper.**—The final settlement of the strike at the Anaconda Company's Chuquicamata mine in Chile nearly half way through November removed from the copper scene the one bull factor of any real significance in the face of the present world surplus. When the settlement came, after a complete shutdown lasting six weeks, there was little or no prior warning. Thus it was that by the time the Chuquicamata settlement was arrived at the small contango that had existed since before the outbreak of the strike at the end of September had given way to a very small backwardation and values had advanced to the upper £220's on the physical effect on world statistics of the Chilean output lost. After a modest initial reaction to the settlement, however, the market remained firm throughout the rest of the month and in fact prices at the very end of the month were the highest since immediately before the strike broke out.<sup>2</sup>

This apparent paradox is quite simply explained. Before the Chilean labour troubles, when the outlook for copper was decidedly weak, the market was given some support by a number of traders who made extensive forward purchases. Since the end of the month these contracts have been maturing and similar contracts are likely to go on maturing for some little time to come. As the metal falls due for delivery those dealers with commitments to meet are finding spot metal in fairly tight supply, this despite the fact that L.M.E. warehouse stocks have for most part been on the up and up for some weeks, and they are thus clinging on to what nearby metal they hold on warrant until their individual contracts mature. Another factor which is already helping to modify bearish sentiment to some extent, in addition to the present technical situation, is the

possibility of a strike at the Braden Copper Company's El Teniente mine at the beginning of next year. After the surprising length of the Chuquicamata stoppage when it first broke out, it will be remembered, most pundits were happily forecasting that it would not last more than a few days at the outside; any future trouble is likely to be taken more seriously from the outset.

Copper consumption in the United Kingdom in September amounted to 65,748 tons, of which 48,621 tons was refined. U.K. production of primary refined in September amounted to 12,954 tons, while secondary refined output was 10,604 tons. Stocks of refined copper again increased to 93,460 tons. Blister copper stocks, however, were lower (16,840 tons compared with 20,785 tons at the end of August).

**Tin.**—The situation in the tin market in November was quite simply one of a certain tightness in supplies of nearby metal which showed itself in a generally steady market with prices hovering around £800 per ton and only occasionally lower.<sup>1</sup> At the same time there was a fairly constant backwardation of the order of about £3 per ton. Some of the strength of the market in the early part of the month was ascribed to a certain amount of influential buying, but over and above this was the strength of the world statistical position. During the month it became fairly certain that Malaya, far from being in a position to flood the market with metal from stock, as had been feared earlier, is only just able to meet current demand and at the moment demand for tin is well below what it could be with activity in United States tinplate industry running at little more than half capacity. Nevertheless, it was forecast mid-way through November that consumption this year would probably exceed new supplies by some 10,000 to 15,000 tons. Such a deficit would, of course, have to be made up by running down existing consumers' stocks, a prospect which makes for continued bullishness in the future. However, towards the end of the month, tin prices began to drift slightly, possibly because of the usual caution which seems to overtake the market with the approach of another Tin Council meeting to fix the quarterly export quotas.

United Kingdom tin consumption in September totalled 1,983 tons, while production was 2,730 tons. Stocks at the end of September amounted to 11,550 tons compared with 11,771 tons at the end of August.

**Lead.**—Interest in lead was not particularly marked in November and over the month as a whole this was reflected in downward drifting prices, though the pace was by no means rapid.<sup>1</sup> Nevertheless, lead is still very much in surplus in the world as a whole. Indeed, the situation seems to get no better and the problems that will have to be faced next time the International Lead and Zinc Study Group meets (in March next year) will be every bit as difficult as those which it skated around at its deliberations in Geneva last September.

The one modestly encouraging immediate factor is the way consumption generally has held up in recent weeks despite short-time working in the motor industry and certain other sectors of the economy. In fact, consumption figures published in November, although relating to September, when conditions were certainly not so depressed as they have been recently, showed a substantial increase over consumption last year at that time.

<sup>1</sup> Recent Prices, pp. 328, 368.

<sup>2</sup> See Table, p. 368.

<sup>1</sup> See Table, p. 368.

Late in November the deputy chairman of Consolidated Zinc Corporation said that accumulations of lead were not really serious. From the reports it is not clear whether he was referring to his company's position or the overall position at the time, but he was definitely speaking of his own group when he also said that it was still having no difficulty in disposing of its production as restricted by international agreement. The market showed no reaction, however.

U.K. September lead consumption amounted to 34,274 tons. September output of English refined lead was 8,318 tons and end-September stocks in this country totalled 58,157 tons, against 59,595 tons at the end of August.

**Zinc.**—Looked at solely from the point of view of price movements the zinc market had been singularly devoid of any features of interest in recent weeks.<sup>1</sup> At one period, however, it did look as though values might break through the £ 90 ceiling which has existed in recent months.

Demand for zinc continued good all through November and in the early part of the month nearby metal proved to be in somewhat short supply in this country, due in part to that fact that U.K. output was somewhat reduced by technical troubles experienced in connexion with the bringing into operation of the sole domestic producer's new process. One effect of this, although domestic output accounts for only a very small proportion of overall United Kingdom consumption, was that towards the middle of the month a small premium over London Metal Exchange prices was being charged on metal needed for prompt delivery to consumers' works. According to some reports the premium paid was very nearly the same as that chargeable in this country for Russian high-grade zinc.

Despite the present troubles in the motor industry consumption seems to have suffered very little so far. Nevertheless the outlook cannot be considered by any means rosy and it was no doubt this consideration that made for quieter conditions generally in the market towards the end of the month.

United Kingdom zinc consumption in September was 33,163 tons. Output in the same month totalled 6,472 tons and stocks at the end of the month were down slightly from the end-August figure (52,717 tons, compared with 53,584 tons previously).

**Iron and Steel.**—While official figures have not yet been published it is anticipated that raw steel production in the United Kingdom during November will surpass the record October average output of 497,000 tons a week. This tremendous rate of activity, however, is being achieved under the cloud of recession in some major steel-consuming industries. The drop in orders for motor cars, which has received widespread publicity, has not, thus far, had any appreciable effect upon the rate of steel production; effects have been cushioned by drastically cutting imports of sheets, which had been running at a high level. However, should the motor trade's setback continue for long or become more serious then mills supplying steel to this industry are bound to feel the pinch.

The fall in demand from the shipbuilding industry, while not as dramatic as the motor industry, is reaching a serious point. Several yards have either completed their last order or are working on their last ship and, naturally, there has been in consequence a steady decline in orders for steel.

Fortunately the sector which supplies shipbuilders—the heavy section and plate mills—has been able to find ready customers in the capital and heavy engineering industries, whose requirements for such material is at a high level indeed. The re-rolling side of the industry also continues to be very active; semis supplies, which were extremely tight a few months ago, have become slightly easier.

Raw steel production this year is expected to reach the "target" of 24½ million tons, which will be the highest level ever attained by the British steel industry. The outlook for 1961, however, is rather uncertain. Some steel quarters are thinking in terms of an output close to this year's total, although the fortunes of the vital motor industry will be, it is widely felt, a decisive factor. At any rate some decline in output in the first quarter of the new year is expected to occur.

**Iron Ore.**—The extremely high rate of production of pig-iron in the U.K. (to meet the heavy requirements of the melting shops) has meant a high rate of home ore production and a big increase in imports. This year British mines are expected to produce about 16.9 million tons, which would be the highest since 1957, while the intake of foreign material is expected to reach the record total of about 17.2 million tons. In the first ten months of this year (latest statistics available) arrivals totalled over 15.1 million tons, against 10.7 million tons last year. Sweden was the leading supplier with over 3.9 million tons (2.6 million tons in the same period of 1959), followed by Canada with 2.97 million tons (2.19 million tons), Algeria 1.7 million tons (1.2 million tons), and Venezuela 1.38 million tons (1.1 million tons).

**Aluminium.**—Most interest in aluminium in November centred on new projects to expand world output. The Kaiser Aluminium and Chemical Corporation has joined up with the Consolidated Zinc Corporation to exploit the vast bauxite deposits at Weipa, in Queensland, which have hitherto been the province of a C.Z.C. subsidiary, the Commonwealth Aluminium Corporation (Comalco). The £100-million scheme envisaged is not new in itself. What it is likely to involve has been known in outline for some time past and indeed it was in the forefront of the headlines only in September when C.Z.C.'s partner in Comalco, British Aluminium, withdrew from the venture. Since then however, Consolidated Zinc has been pushing ahead with its plea and is negotiating with Kaiser with a view to the latter stepping in in British Aluminium's place.

The results of these talks were announced last month and it was stressed that work on the scheme is to start at once with a view to achieving an output rate of about 148,000 tons of aluminium a year by the middle of 1966. Briefly the scheme is as follows:

A new 50-50 joint C.Z.C.-Kaiser company is to be set up to take over Consolidated Zinc's Comalco shares and its two-thirds interest in the new (and as yet unnamed) company to be formed by C.Z.C. and the Tasmanian Government to operate the Bell Bay smelter recently acquired from the Australian Federal Government. It will also take over Consolidated Zinc's rights to exploit the hydro-electric power potential of the Manapouri-Te Anau lakes in New Zealand's South Island and erect a smelter based on this power.

Almost simultaneously with this development, Kaiser was also in the news with another much-vaunted Commonwealth scheme—the development of the Volta project in Ghana. Kaiser officials, who

<sup>1</sup> See Table, p. 368.

have been negotiating on and off with the Ghana authorities for some time, have now initialled the final agreement for the Valco consortium to begin work on the scheme, the outline details of which are even better known than those of the Australian venture. It now remains for them to persuade other primary aluminium producers to participate. Among those likely to be approached are British Aluminium, the Aluminum Co. of Canada, Reynolds Metals, and the Aluminum Co. of America.

While all this was going on, however, Mr. N. V. Davis, president of Aluminium, Ltd., was sounding a warning note on the dangers of expanding production too far in advance of demand. In an address to New York businessmen he said that while the long-term future of the aluminium industry was bright the present over-capacity in the U.S. sector of the industry was but little short of total actual consumption in 1950. Total non-communist production capacity by 1965 might exceed consumption by some 1½ million tons, he said, if contemplated schemes were embarked upon "too quickly and with too little regard for reality".

**Antimony.**—From the point of view of price changes there was little or no new development of any note in the antimony market in November, English regulus remaining at £200 per ton delivered for 99% material and £207 10s. for 99.6%. However, Chinese regulus which had not been on offer for some little time, in fact not since the all-round increase in antimony and antimony products prices in September, was again offered for delivery to consumers in this country from the end of the year onwards at prices fully representative of the new values fixed in September—i.e., £145 to £148 per metric ton c.i.f. for 99% material and £152 to £156 for 99.6%. Russian antimony has not been available in the United Kingdom now for some months and as yet there is no sign of any renewal of offers from that direction.

**Arsenic.**—In November, as in so many months past, arsenic showed no new market features and prices were again constant throughout at £400 per ton for the metal and £40 to £45 per ton ex store for the trioxide.

**Bismuth.**—Despite the increased consumer interest in bismuth shown in recent months the price again held steady in November at a nominal 16s. per lb. for on-ton lots ex warehouse.

**Cobalt.**—November was another uneventful month for the cobalt market and prices again held at the levels established back in March this year—namely, 12s. per lb. delivered on the open market and 10s. 9d. delivered when supplied under contract. The black and grey oxides were also unchanged at 7s. 10d. and 8s. 4d. per lb. delivered.

**Cadmium.**—Effective from November 21 the price of U.K. and Commonwealth cadmium was advanced from 10s. 6d. per lb. to 11s., thus bringing it into line with that of U.S. metal sold in this country. The U.S. price was established (as reported last month) in the early part of October, following an increase in U.S. domestic quotations. The rate for Belgian material sold in this country was subsequently advanced from 10s. 6d. to about 10s. 9d. per lb.

**Chromium.**—An unchanged price of 6s. 11d. to 7s. 4d. per lb. was indicated for chromium metal throughout November.

**Tantalum.**—The good demand for tantalite, which first became evident some weeks ago, really made itself felt in November. With supplies cut

down to some extent because of the present Congo troubles and consumers both in the U.S. and on the Continent clamouring for material, while Japanese consumers were also showing considerable interest, prices were advanced quite early in the month from 700s. to 750s. per long ton unit for ore assaying 60% Ta<sub>2</sub>O<sub>5</sub> to 800s. to 900s. Subsequently they advanced steadily as demand held up until by the end of the month similar material was fetching 1,000s. to 1,200s. per unit.

Even so not all holders of the ore were prepared to sell, no doubt believing that still higher prices were in prospect. Another factor they may well have had in the backs of their minds is the present trend among consumers for liquid-liquid treatment of both tantalite and columbite ores, thereby enabling them to turn to advantage the content of columbite in tantalite and the content of tantalite in columbite. Normally, of course, when an ore consists mainly of one or the other of these the other is regarded as impurity for commercial purposes, but when it is 1:1 ratio material both are equally valuable. In recent months consumer demand for 1:1 ratio material has been higher than in the past and prices have forged ahead. The high-ratio material quoted above has also been increasingly attractive and maintained its premium over the even-ratio ore.

**Platinum.**—The platinum market has been quite dead in the past few weeks. Turnover in free supplies has been at a minimum, demand being almost entirely lacking. However, there has also been a complete lack of cheap offers for some time past and this, together with the stable price policy currently being pursued by South African and Canadian producing interests, has helped to keep prices in recent weeks at £28 5s. to £28 15s. per troy oz. for free market metal and £30 5s. for Commonwealth material.

**Iridium.**—Iridium sponge and powder prices were unchanged throughout November at £20 to £26 15s. per troy oz.

**Palladium.**—In common with the other platinum metals palladium was featureless from the market viewpoint in November and prices were stable at £8 10s. to £9 7s. 6d. per troy oz.

**Osmium.**—Osmium was again priced at £18 to £25 per troy oz. in November.

**Tellurium.**—Tellurium prices showed no change during November lump and powdered again being quoted at 28s. 6d. per lb., while tellurium sticks (99% minimum) were priced at 40s. per lb.

**Tungsten.**—November was the quietest month in the tungsten-ore market for some time with prices for Contract "B" material steady all through at 148s. to 153s. per long ton unit c.i.f. Business all through the month was only moderate, actual deals for the most part being done in the bottom half of the range or at best only at middle prices. Most consumer interest came from the home market until the last few days of the month, when demand from overseas while not high supplemented domestic enquiry.

**Nickel.**—The big event of the month as regards nickel was the disclosure by the Japanese Trade Ministry that it was seeking rationalization of the Japanese nickel industry to pave the way for liberalization of imports. What is being sought is a reduction in the present difference between the cost of Japanese-produced nickel and the world market level. Currently Japanese nickel costs about 1,150,000 yen per ton, against the 600,000 yen per

ton charged for imported metal. To this end the Japanese nickel industry as a whole is being urged to switch its source of nickel ore supplies from New Caledonia (garnierite) to Canada and Africa (nickel sulphide ore). Eventually, by 1965, it is hoped to have cut domestic prices by about 850,000 yen per ton and in the meantime output is to be restricted to 6,000 tons a year, against the present 9,500 tons. Any deficiency will be covered by imports, which are to be liberalized next year or the year after under a tariff quota system which will subject all imports above a certain figure to special import duties.

As far as the normal producer-maintained nickel price was concerned last month it was again steady at £600 per ton delivered for refined metal.

**Chrome Ore.**—The chrome-ore market was again pretty well devoid of specific new features in November. Deliveries continued on the basis of existing contracts and there were further negotiations between various suppliers and consumers over 1961 contracts, though again at prices no different from those ruling in past months. Wetter weather in Northern Europe raised some hopes for a better power situation in Scandinavia, where a shortage of water has meant some reduction in ferro-chrome output in past months because of the resultant shortage of hydro electricity. Any improvement would no doubt make for an increased rate of chrome-ore consumption over the next few months while ferro-chrome producers tried to make good the backlog of orders from the steel industry. The long-term outlook for any sustained increase in chrome-ore usage is less hopeful, however, for there

is a risk of new demand for ferro-chrome lessening over the next few months if the economic picture deteriorates.

Rhodesian metallurgical chrome remains quoted at £15 5s. per ton c.i.f. Turkish metallurgical grade material is still nominally priced at \$33.50 per ton, f.o.b.

**Molybdenite.**—Molybdenite prices in November were unchanged at 8s. 11d. per lb. Mo for Climax material f.o.b. mine and 9s. 3½d. per lb. c.i.f. for material from other sources.

Early in the month American Metal Climax reported on the position for the first nine months of the year, saying that overall demand was strong throughout, resulting in a 70% increase in the company's income from molybdenum alone. Although United States demand had fallen off somewhat in the third quarter, the company said, owing to the lower rate of activity in the domestic steel industry, foreign demand and sales abroad had more than made up for this.

**Manganese Ore.**—There was no change in the c.i.f. Europe quotation of 66d. to 71d. per unit for manganese ore during November and trading generally was quiet. However, consumers are now negotiating supply contracts for 1961 and according to some reports are tending to strike hard bargains with the producers whose offering prices many consumers—if not all of them—tend to regard as somewhat unrealistic. It is believed in some quarters therefore that a new overall price structure somewhat below the existing paper one may finally emerge when details of the 1961 contracts become finally known.

### Tin, Copper, Lead, and Zinc Prices

Tin, minimum 99.75% ; Copper, electro ; Lead, minimum 99.75% ; and Zinc, minimum 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
Nov. 10	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
11	800 0	797 15	227 12½	227 12½	69 12½	69 17½	88 15	87 12½
14	799 10	796 10	224 7½	223 17½	67 8½	68 6½	86 7½	86 6½
15	803 0	798 10	225 12½	225 2½	67 17½	68 17½	86 8½	86 18½
16	804 0	799 5	226 7½	225 17½	68 3½	68 16½	87 7½	87 12½
17	802 10	798 10	225 12½	224 15	67 17½	68 16½	86 7½	86 13½
18	802 0	797 5	226 2½	225 7½	68 11½	69 1½	86 13½	86 18½
21	800 10	797 15	227 7½	225 17½	68 8½	68 18½	87 6½	87 6½
22	800 0	796 15	229 10	228 0	67 13½	68 7½	88 2½	87 11½
23	802 0	797 15	229 17½	227 17½	67 15	68 11½	87 17½	87 8½
24	801 10	798 5	228 12½	226 12½	67 13½	68 8½	87 7½	86 17½
25	801 0	798 5	228 12½	226 5	67 6½	68 3½	86 12½	86 6½
28	799 10	796 15	229 17½	227 7½	66 17½	67 15	86 18½	86 6½
29	799 0	796 10	231 2½	228 7½	66 16½	67 13½	86 18½	86 3½
30	799 10	797 15	231 2½	227 17½	66 7½	67 16½	86 17½	86 1½
Dec. 1	800 0	798 0	231 17½	228 12½	66 13½	67 18½	86 2½	85 13½
2	799 10	797 5	232 12½	229 7½	66 11½	67 16½	86 6½	85 13½
5	800 0	797 15	233 17½	230 7½	66 7½	67 11½	86 5	85 13½
6	799 0	796 15	235 0	231 7½	66 8½	67 13½	86 13½	86 0
7	798 10	795 15	234 7½	230 17½	66 7½	67 12½	86 12½	86 3½
8	798 10	795 15	234 12½	231 7½	66 1½	67 7½	86 17½	86 2½
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## Statistics

## TRANSVAAL AND O.F.S. GOLD OUTPUTS

	OCTOBER		NOVEMBER	
	Treated Tons	Yield Oz.*	Treated Tons	Yield Oz.†
Blyvooruitzicht .....	135,000	87,280	135,000	87,548
Brakpan .....	146,000	17,746	142,000	17,666
Buffelsfontein† .....	148,000	61,162	148,000	61,054
City Deep .....	121,000	24,266	117,000	24,185
Cons. Main Reef .....	52,000	10,840	48,000	10,763
Crown Mines .....	198,000	33,810	184,000	33,075
Daggafontein .....	225,000	45,560	220,000	44,700
Dominion Reef .....	42,000	533	43,100	576
Doomfontein† .....	105,000	43,367	105,000	43,267
D'r'n Roopeport Deep .....	195,000	35,236	185,000	33,796
East Champ D'Or† .....	12,000	305	12,500	298
East Daggafontein .....	108,000	18,362	108,000	18,362
East Geduld .....	129,000	37,410	125,000	36,250
East Rand P.M. ....	227,000	51,370	216,000	50,265
Eastern Transvaal Consol .....	19,000	5,969	19,700	5,978
Ellatont .....	27,000	6,416	26,000	6,191
Freddies Consol .....	68,000	15,225	69,000	12,628
Free State Geduld .....	95,000	82,158	95,000	82,173
Free State Saaiplaas .....	25,000	50,827	30,000	67,123
Geduld .....	80,000	13,500	78,000	13,166
Government G.M. Areas‡ .....	52,000	10,291	53,000	10,275
Grovetuil Proprietary .....	225,000	46,579	225,000	46,578
Harmony Gold Mining .....	108,000	63,308	170,000	68,941
Hartebeestfontein† .....	114,000	54,570	125,000	58,127
Libanon .....	17,000	27,859	17,000	27,859
Lorraine .....	82,000	17,914	82,000	17,917
Luipaards Vlei† .....	120,000	13,376	118,000	13,411
Marievale Consolidated .....	98,000	24,059	98,000	24,059
Modderfontein East .....	126,000	12,544	120,000	11,535
New Kleinfontein .....	80,000	10,227	78,000	10,288
New Klerksdorp† .....	10,000	1,367	10,500	1,611
President Brand .....	118,500	94,806	118,500	94,503
President Steyn .....	105,000	39,063	108,000	40,229
Rand Leases .....	188,000	26,508	184,000	26,312
Randfontein† .....	158,000	10,199	158,000	9,982
Rietfontein Consolidated .....	15,000	3,668	14,000	3,400
Robinson Deep .....	46,500	10,251	45,000	10,253
Rose Deep .....	24,000	4,102	25,000	4,280
St. Helena Gold Mines .....	178,000	61,855	178,000	61,853
Stimmer and Jack .....	74,000	13,318	72,000	12,731
S. African Land and Ex. .....	90,000	20,603	100,000	20,751
S. Roodepoort M.R. ....	31,000	7,393	30,000	7,172
Sparwater Gold .....	11,000	3,431	11,000	3,432
Springs .....	94,000	12,906	95,000	12,942
Stillfontein Gold Mining† .....	108,000	76,300	108,000	76,306
Sub Nigel .....	66,500	15,195	66,500	15,046
Transvaal G.M. Estates .....	6,600	1,931	—	—
Vaal Reef† .....	104,000	47,840	101,000	46,966
Van Dyk Consolidated .....	74,000	11,506	75,000	11,476
Venterspost Gold .....	122,000	33,965	122,000	34,032
Village Main Reef .....	20,000	4,003	28,500	4,018
Virginia O.F.S.‡ .....	130,000	27,853	140,000	29,981
Vlakfontein .....	51,000	18,572	51,000	18,561
Vogelstruisbult† .....	85,000	17,914	84,000	17,648
Welkom Gold Mining .....	99,000	31,532	99,000	31,641
West Driefontein† .....	130,000	121,518	130,000	121,547
West Rand Consol.† .....	212,000	21,800	206,000	20,302
Western Holdings .....	157,000	105,972	155,000	105,662
Western Reefs .....	131,000	37,478	135,000	38,813
Winkelhaak .....	95,000	32,062	95,000	32,200
Witwatersrand Nigel .....	20,000	4,435	20,000	4,435

† 253s. 10d. \* 254s. 0d. ‡ Gold and Uranium.

## COST AND PROFIT IN THE UNION\*

	Tons milled	Yield per ton	Work's cost per ton	Work's profit per ton	Total working profit
Sept. 1959 .....	18,214,200	s. d. 70 5	s. d. 45 2	s. d. 25 3	£ 30,140,529
Oct. ....	—	—	—	—	—
Nov. ....	—	—	—	—	—
Dec. ....	17,070,000	72 2	45 10	26 4	30,559,937
Jan., 1960 .....	—	—	—	—	—
Feb. ....	—	—	—	—	—
Mar. ....	17,464,400	72 8	46 5	26 3	30,105,571
April .....	—	—	—	—	—
May .....	—	—	—	—	—
June .....	17,068,300	73 9	46 3	27 6	31,941,743
July .....	—	—	—	—	—
August .....	—	—	—	—	—
Sept. ....	18,103,100	74 0	46 4	27 8	32,201,685

\* 3 Months.

## PRODUCTION OF GOLD IN SOUTH AFRICA

	RAND AND O.F.S.	OUTSIDE	TOTAL
	Oz.	Oz.	Oz.
November, 1959 .....	1,688,379	34,903	1,723,282
December .....	1,662,043	31,309	1,693,352
January, 1960 .....	1,701,110	34,051	1,735,161
February .....	1,675,248	38,859	1,714,107
March .....	1,664,514	38,744	1,703,258
April .....	1,734,310	36,720	1,771,030
May .....	1,705,880	37,897	1,803,777
June .....	1,775,335	37,530	1,812,865
July .....	1,776,141	39,673	1,815,814
August .....	1,778,711	36,777	1,815,488
September .....	1,774,967	35,362	1,810,319
October .....	1,777,495	35,967	1,813,462

## NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	GOLD MINES	COAL MINES	TOTAL
February 29, 1960 .....	385,027	32,144	417,171
March 31 .....	388,890	30,696	419,586
April 30 .....	385,841	—	—
May 31 .....	383,212	30,933	414,145
June 30 .....	380,593	31,435	412,028
July 31 .....	378,626	31,879	410,505
August 31 .....	374,303	32,321	406,624
September 30 .....	369,751	32,096	402,747
October 31 .....	368,391	33,387	401,778

## MISCELLANEOUS METAL OUTPUTS

	4-Week Period		
	To Nov. 19		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South .....	23,900	5,858	4,356
Electrolytic Zinc .....	17,976	1,013	4,891
Lake George .....	18,400	1,337	2,748
Mount Isa Mines** .....	63,966	4,304†	4,487
New Broken Hill .....	62,900	6,582	15,768
North Broken Hill .....	35,232	6,729	7,417
Zinc Corp. ....	71,070	10,593	12,502
Rhodesia Broken Hill* .....	—	—	—

\* 3 Months, \*\* Copper 3,275 tons blister; 9,541 tons concs.; † Metal

## RHODESIAN GOLD OUTPUTS

	OCTOBER		NOVEMBER	
	Tons	Oz.	Tons	Oz.
Cam and Motor .....	—	—	—	—
Falcon Mines .....	22,500	4,354	22,500	4,398
Globe and Phoenix .....	6,300	2,972	6,150	3,168
Matapa Gold Mining .....	—	—	—	—
Maze .....	2,645	—	3,028	—
Coronation Syndicate .....	11,571	—	11,862	—
Phoenix Prince* .....	—	—	—	—

\* 3 Months.

## WEST AFRICAN GOLD OUTPUTS

	OCTOBER		NOVEMBER	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket .....	48,831	11,433	51,942	12,044
Ariston Gold Mines .....	33,400	9,954	40,330	11,154
Ashanti Goldfields .....	37,000	30,000	37,500	30,000
Bibiani .....	33,000	6,900	33,000	6,800
Bremang .....	—	3,912	—	—
Ghana Main Reef .....	11,224	4,347	11,033	4,220
Konongo .....	7,200	3,894	6,950	3,814
Lyndhurst .....	—	—	—	—

## PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1959		1960	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January.....	46,489	18,077	44,902	29,711
February.....	43,366	19,806	45,754	29,865
March.....	48,397	17,394	45,309	29,656
April.....	46,315	5,694	48,007	6,847
May.....	46,423	40,280	47,542	62,912
June.....	49,935	31,386	45,884	34,268
July.....	46,512	32,734	44,865	33,323
August.....	38,727	29,178	48,284	28,931
September.....	56,760	33,837	—	—
October.....	48,528	32,314	—	—
November.....	47,916	31,092	—	—
December.....	47,452	31,175	—	—

## WESTRALIAN GOLD PRODUCTION

	1958	1959	1960
	Oz.	Oz.	Oz.
January.....	66,562	63,924	64,794
February.....	65,965	65,035	66,789
March.....	65,420	65,408	61,941
April.....	60,855	62,686	65,373
May.....	64,196	64,184	66,682
June.....	67,929	74,590	74,902
July.....	81,106	78,974	67,623
August.....	68,610	—	67,481
September.....	68,744	—	68,704
October.....	70,128	70,427	67,310
November.....	67,562	68,858	—
December.....	120,106	117,474	—
Total.....	867,187	861,122	—

## AUSTRALIAN GOLD OUTPUTS

	4-WEEK PERIOD			
	To Oct. 11		To Nov. 8	
	Tons	Oz.	Tons	Oz.
Central Norseman.....	14,170	8,118	14,137	6,852
Gold Mines of Kalgoorlie.....	39,191	10,318	41,581	11,545
Gt. Boulder Gold Mines*.....	—	—	—	—
Gt. Western Consolidated.....	31,796	5,436	31,873	5,286
Lake View and Star.....	—	—	—	—
North Kalbarri.....	28,408	7,237	28,612	7,611
Sons of Gwalia.....	12,538	2,525	12,734	2,594
Mount Morgan.....	—	5,618	—	5,172

\* 3 Months.

## ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n \$
June, 1959.....	768,725	213,486	31,692	7,178,823
July.....	774,749	221,814	32,172	7,498,030
August.....	683,819	191,598	29,141	6,428,545
September.....	754,208	213,772	34,139	7,116,556
October.....	794,630	227,192	34,733	7,558,567
November.....	770,437	227,176	35,262	7,600,949
December.....	775,803	221,377	40,807	7,388,654
January, 1960.....	778,103	226,856	27,617	7,550,068
February.....	755,569	222,484	35,003	7,446,848
March.....	804,369	229,457	37,202	7,646,044
April.....	779,487	218,393	42,967	7,426,262
May.....	784,391	225,550	32,174	7,705,153
June.....	791,488	223,833	49,765	7,756,490
July.....	779,426	222,179	37,002	7,664,968
August.....	712,792	202,025	35,722	6,883,254
September.....	772,984	208,019	29,251	7,114,785

## MISCELLANEOUS GOLD AND SILVER OUTPUTS

	OCTOBER		NOVEMBER	
	Tons	Oz.	Tons	Oz.
Clutha River.....	—	600	—	702
Lampa (Peru)†.....	—	35,412	—	43,350
New Guinea Goldfields.....	4,142	1,314	—	—
Yukon Consol.....	—	\$292,000	—	—

† Oz. Silver: Copper, 108 tons; 127 tons.

## AUSTRALIAN BASE-METAL OUTPUTS

Period	Concentrate Production (Long Tons)		
	Zinc	Copper (a)	Lead
1959.....	246,693	89,162	305,163
Provisional	—	—	—
1959-January.....	12,946	7,744	14,874
February.....	23,658	8,493	26,361
March.....	27,377	9,776	30,402
April.....	82,992	8,142	23,477
May.....	25,122	9,400	26,852
June.....	27,786	10,087	29,288
July.....	17,570	10,351	19,861
August.....	28,115	9,757	26,247
September.....	—	—	—
October.....	—	—	—
November.....	—	—	—
December.....	—	—	—

(a) includes Cu content of direct smelting ore.

## OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	SEPT.	OCT.	NOV.
Ampat Tin.....	68½	91½	99
Austral Amalgamated.....	—	—	—
Ayer Hitam.....	638*	—	—
Batu Selangor.....	—	—	—
Berjuntai.....	274	238½	218
Chenderiang.....	52*	—	—
Gopeng Consolidated.....	470*	—	—
Hongkong Tin.....	80*	—	—
Idris Hydraulic.....	101*	—	—
Ipo.....	67*	—	—
Jelapang Tin.....	—	—	—
Kampong Lanjut.....	175	283½	277
Kamunting.....	118½	147½	139
Kent (F.M.S.).....	61*	—	—
Killinghall.....	76*	—	—
Kinta Kellas.....	112*	—	—
Kinta Tin Mines.....	26½	—	—
Klang River.....	—	—	—
Kramat.....	51	52	45½
Kuala Kampar.....	110	129	126
Kuala Lumpur.....	—	—	—
Kuchai.....	—	—	—
Lahat Mines.....	—	—	—
Larut.....	9½	17	33
Lower Perak.....	119	117	52
Malayan.....	980*	—	—
Malaysiam.....	—	8	7½
Pacific Tin Consolidated.....	—	—	—
Pahang Consolidated.....	646*	—	—
Pengkalen.....	97*	—	—
Petaling Tin.....	324*	—	—
Puket.....	—	—	—
Rahman Hydraulic.....	—	28½	26
Rambutan.....	44*	—	—
Rantau.....	57	64	63
Rawang Concessions.....	—	—	—
Rawang Tin Fields.....	—	—	—
Renong.....	156*	—	—
Selayang.....	5½*	—	—
Siamese Tin Syndicate (Malaya).....	42	45	—
Southern Kinta.....	297	345	325½
Southern Malayan.....	820*	—	—
Southern Tronoh.....	—	—	—
Sungei Besi.....	541*	—	—
Sungei Kinta.....	—	—	—
Sungei Way.....	325½*	—	—
Taipung Consolidated.....	—	—	—
Tambah.....	—	—	—
Tanjong.....	248½*	—	—
Tekka.....	—	—	—
Tekka-Taipung.....	—	—	—
Tongkah Compound.....	—	—	—
Tongkah Harbour.....	166½	143	183
Tronoh.....	822*	—	—
Ulu Klang.....	—	—	—

\* 3 Months.

## MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	Oct.		Nov.	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines...	406	57	410	—
Anglo-Burma Tin*	—	—	—	—
Bangrin	45	—	—	—
Beral	4	170†	4	172†
Bisichi	70	47‡	58‡	40
Ex-Lands Nigeria	52	—	44	—
Geevor	60	—	55	—
Gold and Base Metal	62	5	—	—
Jantar Nigeria	23‡	23‡	20	29
Jos Tin	11	—	—	—
Kaduna Prospectors	10	—	6	—
Kaduna Syndicate	26	—	19	—
Katu Tin	37	—	—	—
Kefi Tin	—	—	—	—
London Nigerian Mines	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	—	—	—	—
Naraguta Karama	10‡	—	—	—
Naraguta Tin	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria)	—	—	—	—
Siamese Tin Syndicate	96	—	—	—
South Bukuru	—	—	—	—
South Crofty	69	—	80	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	26	3‡	—	—

\* 3 Months. † Wolfram.

## SOUTH AFRICAN MINERAL OUTPUT

September, 1960.

Gold	1,813,691 oz.
Silver	186,649 oz.
Diamonds	264,694 carats.*
Coal	3,562,395 tons.
Copper	(a) — tons in matte and copper-gold concentrates. (b) 4,409 tons of 99.10% 222 tons concs.
Tin	—
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	15,819 tons.
Chrome Ore	69,682 tons.
Manganese Ore	115,839 tons.
Lead Concs.	80 tons.

\* August, 1960.

## IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

	SEPT.	OCT.
Iron Ore	1,659,043	1,592,014
Manganese Ore	63,151	11,236
Iron and Steel	161,540	104,487
Iron Pyrites	8,490	21,451
Copper Metal	46,024	45,496
Tin Ore	4,769	4,896
Tin Metal	135	1
Lead	16,442	19,626
Zinc Ore and Concs.	14,364	11,877
Zinc	14,096	12,351
Tungsten Ores	467	632
Chrome Ore	33,862	26,135
Bauxite	42,533	37,765
Antimony Ore and Concs.	1,295	1,285
Titanium Ore	61,873	11,144
Tantalite/Columbite	40	82
Sulphur	47,261	27,406
Barytes	5,179	2,238
Asbestos	14,325	17,924
Magnesite	8,055	9,783
Mica	774	637
Graphite	1,135	763
Mineral Phosphates	120,296	70,477
Molybdenum Ore	534	495
Silicon	656	374
Nickel	46,579	57,798
Aluminium	496,007	418,142
Mercury	124,655	95,910
Bismuth	149,224	43,941
Calcium	271,977	261,964
Cobalt and Cobalt Alloys	330,046	429,572
Selenium	9,723	35,791
Petroleum Motor Spirit	1,000 gals.	57,801
Crude	1,005,573	1,034,763

## Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	98	0	0
" 80% Technical	"	90	0	0
Alum., Comm.	"	25	0	0
Aluminium Sulphate	"	16	10	0
Ammonia, Anhydrous	per lb.	59	0	0
Ammonium Carbonate	per ton	28	12	6
" Chloride, 98%	"	36	5	0
" Nitrate	"	42	0	0
Antimony Sulphide, golden	per lb.	47	10	0
Arsenic, White, 99/100%	per ton	42	0	0
Barium Carbonate 98-99%	"	45	0	0
" Chloride	"	20	0	0
Barytes (Bleached)	"	5	2	
Benzene	per gal.	30	7	6
Bleaching Powder, 35% Cl.	per ton	46	0	0
Borax	"	77	0	0
Boric Acid, Comm.	"	40	17	9
Calcium Carbide	"	13	5	0
" Chloride, solid, 70/75%	"	1	4	
Carbolic Acid, crystals	per lb.	62	10	0
Carbon Bisulphide	per ton	2	2	
Chromic Acid (ton lots)	per lb.	11	0	1
Citric Acid	per cwt.	76	10	0
Copper Sulphate	per ton	1	2	
Crescote Oil (f.o.r. in Bulk)	per gal.	7	0	
Cresylic Acid, refined	"	13	6	
Hydrochloric Acid 28° Tw.	per carboy	1	1	
Hydrofluoric Acid, 59/60%	per lb.	17	4	
Iodine	per kilo	3	5	0
Iron Sulphate	per ton	115	5	0
Lead, Carbonate, white	"	110	0	0
" Nitrate	"	104	5	0
" Oxide, Litharge	"	102	5	0
" Red	"	40	0	0
Lime Acetate, brown	"	57	10	0
Lithopone	"	20	0	0
Magnesite, Calcined	"	13	0	0
" Raw	"	20	0	0
Magnesium Chloride	"	15	10	0
Sulphate, Comm.	"	6	1	
Methylated Spirit, Industrial, 66 O.P.	per gal.	189	0	0
Nickel Sulphate	per ton	35	0	0
Nitric Acid, 80° Tw.	"	132	0	0
Oxalic Acid	"	1	4	
Phosphoric Acid (S.G. 1.750)	per lb.	1	2	
Potassium Bichromate	"	2	6	
" Bromide	"	72	10	0
" Carbonate (hydrated)	per ton	21	0	0
" Chloride	"	19	3	0
" Iodide	per kilo	3	10	0
" Hydrate (Caustic) solid	per cwt.	198	0	0
" Nitrate	per ton	20	5	0
" Sulphate, 50%	"	70	0	0
Sal-Ammoniac	"	63	0	0
Sodium Acetate	"	Nominal		
" Arsenate, 58-60%	"	18	10	0
" Bicarbonate	"	1	0	
" Carbonate (Soda Ash) 58%	per lb.	16	0	0
" Chlorate	"	77	10	0
" Cyanide	per cwt.	6	18	10
" Hydrate, 76/77% solid	per ton	33	0	0
" Hyposulphite, Comm.	"	35	0	0
" Nitrate, Comm.	"	25	3	0
" Phosphate (Dibasic)	"	40	10	0
" Prussiate	per lb.	11	10	0
" Silicate	per ton	12	15	0
" Sulphate (Glauber's Salt)	"	10	0	0
" (Salt-Cake)	"	38	12	6
" Sulphide, flakes, 60/62%	"	27	15	0
" Sulphite, Comm.	"	13	0	0
Sulphur, American, Rock (Truckload)	"	17	10	0
" Ground, Crude	"	12	0	0
Sulphuric Acid, 108° Tw.	"	8	10	0
" free from Arsenic, 140° Tw.	"	14	18	6
Superphosphate of Lime, 18% P <sub>2</sub> O <sub>5</sub>	"	Nominal		
Tin Oxide	"	172	0	0
Titanium Oxide, Rutile	"	85	0	0
" White, 25%	"	95	0	0
Zinc Chloride	"	131	0	0
" Dust, 95/97% (4-ton lots)	"	105	10	0
" Oxide	"	32	0	0
" Sulphate	"			

# Share Quotations

Shares of £1 par value except where otherwise stated.

	Nov. 8, 1960		Dec. 8, 1960	
	£	s. d.	£	s. d.
<b>GOLD AND SILVER:</b>				
<b>SOUTH AFRICA:</b>				
Blinkpoort (5s.)	3	7 3	1	11 3
Blyvooruitzicht (2s. 6d.)	1	9 0	1	9 6
Brakpan (3s.)	5	9 5	5	0 0
Buffelsfontein (10s.)	2	7 6	2	1 6
City Deep	1	2 6	19	0 0
Consolidated Main Reef	17	0 0	15	0 0
Crown Mines (10s.)	1	8 3	1	7 6
Daggafontein (5s.)	1	1 0	1	2 9
Dominion Reefs (5s.)	1	11 6	1	11 0
Doomfontein (10s.)	1	7 6	1	7 3
Durban Roodepoort Deep (10s.)	1	18 3	1	16 0
East Champ d'Or (2s. 6d.)	1	1 9	1	1 9
East Daggafontein (10s.)	1	11 3	10	9 0
East Geduld (4s.)	1	1 0	1	0 0
East Rand Ext. (5s.)	1	2 6	19	3 3
East Rand Proprietary (10s.)	2	0 9	1	18 3
Fredries Consol.	6	9 9	6	9 9
Free State Dev. (5s.)	6	17 6	6	8 9
Free State Geduld (5s.)	3	6 3	3	3 9
Free State Saaiplaas (10s.)	10	3 3	8	3 3
Geduld	3	6 3	3	3 9
Government Gold Mining Areas (3d.)	3	3 3	3	0 0
Grootvlei (5s.)	1	2 3	1	1 3
Harmony (5s.)	1	14 0	1	9 6
Hartebeestfontein (10s.)	2	14 6	2	9 0
Libanon (10s.)	16	6 6	15	9 9
Loraine (10s.)	1	8 6	1	7 6
Luijaards Vlei (2s.)	7	9 9	7	9 9
Marievale (10s.)	1	8 9	1	8 6
Modderfontein B (3d.)	2	0 0	1	6 6
Modderfontein East	13	9 9	12	9 9
New Kleinfontein	5	6 6	5	3 3
New Pioneer (5s.)	1	16 3	1	13 9
New State Areas (15s. 6d.)	9	9 9	9	9 9
President Brand (5s.)	3	6 3	3	1 3
President Steyn (5s.)	1	2 6	1	2 3
Rand Leases (5s. 3d.)	8	3 3	7	9 9
Randfontein	18	6 6	18	0 0
Rietfontein (3d.)	3	6 3	3	6 3
Robinson Deep (5s. 6d.)	5	0 0	5	0 0
Rose Deep (3d.)	7	0 0	7	0 0
St. Helena (10s.)	4	2 6	3	19 3
Simmer and Jack (1s. 6d.)	2	0 0	1	6 6
South African Land (3s. 6d.)	18	0 0	17	9 9
Springs (3d.)	1	9 9	1	9 9
Stilfontein (5s.)	1	16 3	1	16 0
Sub Nigel (3d.)	9	3 3	9	6 6
Vaal Reefs (5s.)	2	8 3	2	5 6
Vaal Dyk (3d.)	3	3 3	3	0 0
Venterspost (10s.)	1	4 3	1	3 0
Virginia (5s.)	4	3 3	3	9 9
Vlakfontein (10s.)	18	9 9	17	6 6
Vogelstruisfontein (3d.)	5	6 6	5	0 0
Welkom (5s.)	16	6 6	16	6 6
West Driefontein (10s.)	4	18 3	4	17 6
West Rand Consolidated (10s.)	1	2 3	1	0 0
West Witwatersrand Areas (2s. 6d.)	3	10 3	3	5 9
Western Holdings (5s.)	8	1 3	7	15 0
Western Reefs (5s.)	1	12 0	1	10 6
Winkelhaak (10s.)	1	7 0	1	7 6
Witwatersrand Nigel (2s. 6d.)	1	3 3	1	0 0
Zandpan (10s.)	13	3 3	12	0 0
<b>RHODESIA:</b>				
Cam and Motor (2s. 6d.)	—	—	—	—
Chicago-Gaika (10s.)	15	0 0	15	0 0
Coronation (2s. 6d.)	5	0 0	5	0 0
Falcon (5s.)	9	9 9	9	9 9
Globe and Phoenix (5s.)	1	11 3	1	12 3
Motapa (5s.)	—	—	—	—
<b>GHANA:</b>				
Amalgamated Bantek (3s.)	9	7 3	9	7 3
Ariston Gold (3s. 6d.)	3	0 0	2	9 9
Ashanti Goldfields (4s.)	15	9 9	15	0 0
Bibiani (4s.)	2	6 6	2	3 3
Bremang Gold Dredging (5s.)	2	6 6	2	3 3
Ghana Main Reef (5s.)	2	0 0	1	9 9
Konongo (2s.)	1	3 3	1	3 3
Kwahu (2s.)	5	0 0	4	6 6
Offin River (2s. 6d.)	2	6 6	2	0 0
Western Selection (5s.)	4	0 0	3	6 6
<b>AUSTRALASIA:</b>				
Gold Fields Aust. Dev. (3s.) W.A.	1	6 6	1	6 6
Gold Mines of Kalgoolie (10s.)	8	9 9	8	0 0
Great Boulder Propriet'ys (2s.) W.A.	12	9 9	12	3 3
Lake View and Star (4s.) W.A.	1	13 6	1	10 0
Mount Morgan (10s.) Q.	14	0 0	13	6 6
New Guinea Gold (4s. 3d.)	2	0 0	1	9 9
North Kalbarli (1912) (2s.) W.A.	12	6 6	12	0 0
Sons of Gwalla (10s.) W.A.	2	9 9	2	9 9
Western Mining (5s.) W.A.	9	9 9	9	9 9

## MISCELLANEOUS:

Fresnillo (\$1.00)	1 7 3
Kentana Gold Areas	1 1 3
St. John d'el Rey, Brazil	4 5 6
Yukon Consolidated (\$1)	4 6

## COPPER:

Bancroft Mines (5s.), N. Rhodesia	16 6	15 3
Esperanza (2s. 6d.), Cyprus	1 6	1 4 3
Indian (2s.)	4 9	4 9
MTD (Mangula) (5s.)	8 0	7 0
Messina (5s.), Transvaal	18 3	16 0
Mount Lyell (5s.), Tasmania	6 3	4 6
Nchanga Consolidated, N. Rhodesia	2 7 0	2 6 9
Rhokana Corporation, N. Rhodesia	5 6	5 3
Roan Antelope (5s.), N. Rhodesia	1 10 0	1 7 6
Tanganyika Concessions (10s.)		

## LEAD-ZINC:

Broken Hill South (1s.), N.S.W.	8 9	9 3
Burma Mines (3s. 6d.)	1 6	1 3
Consol. Zinc Corp. Ord.	3 4 3	3 3
Lake George (5s.), N.S.W.	2 7 6	2 6 3
Mount Isa, Queensland (5s. Aust.)	1 19 6	1 19 0
New Broken Hill (5s.), N.S.W.	15 6	15 0
North Broken Hill (10s.), N.S.W.	7 3	7 3
Rhodesia Broken Hill (5s.)	16 3	16 3
San Francisco (10s.), Mexico		

## TIN:

Amalgamated Tin (5s.), Nigeria	10 0	9 6
Ampat (4s.), Malaya	11 3	11 9
Ayer Hitam (5s.), Malaya	1 3 9	19 0
Beralt (5s.), Portugal	1 11 0	1 10 9
Bisichi (2s. 6d.), Nigeria	5 3	5 3
Ex-Lands (2s.), Nigeria	3 3	3 0
Geevor (5s.), Cornwall	19 0	18 6
Gold Base Metals (2s. 6d.), Nigeria	1 10 4	1 9 9
Hongkong (5s.), Malaya	8 0	10 9
Jantar Nigeria (3s.)	6 2 9	2 6 6
Kaduna Syndicate (2s.), Nigeria	14 9	14 0
Kamunting (5s.), Malaya	1 4 6	1 4 0
Malayan Tin Dredging (5s.)	1 0	1 0
Mawchi Mines (4s.), Burma	1 3	1 3
Naraguta Karama (5s.), Nigeria	9 9	8 9
Pahang (5s.), Malaya	13 0	13 0
Siamese Synd. (5s.)	4 3	4 3
South Crofty (5s.), Cornwall	1 5 3	1 6 0
Southern Kinta (5s.), Malaya	1 1 9	18 9
Sungei Besi (4s.), Malaya	1 4 0	1 1 6
Sungei Kinta, Malaya	14 0	13 6
Sungei Way (2s. 4d.), Malaya	4 3	3 9
Tenoh (7s. 6d.), Malaya	3 0	3 0
Tronoh (5s.), Malaya	1 17 3	1 13 6
United Tin Areas (2s. 6d.), Nigeria	2 0	2 0

## DIAMONDS:

Anglo American Investment	12 12 6	12 5 0
Consol African Selection Trust (5s.)	1 4 3	1 0 9
Consolidated of S.W.A. Pref. (10s.)	10 6	10 6
De Beers Deferred (5s.)	7 13 6	7 8 3

## FINANCE, ETC.

African & European (10s.)	3 10 0	3 7 6
Anglo American Corporation (10s.)	8 10 0	8 5 9
Anglo Transvaal 'A' (5s.)	1 17 6	1 17 6
British South Africa (15s.)	3 10 6	3 8 9
British Tin Investment (10s.)	1 7 6	1 8 0
Broken Hill Proprietary	3 13 0	3 11 0
Camp Bird (10s.)	9 3	9 0
Central Mining	4 0 3	3 19 3
Central Provinces Manganese (10s.)	1 6 9	1 4 3
Consolidated Gold Fields	3 11 0	3 8 6
Consolidated Mines Selection (10s.)	1 11 3	1 14 0
Corner House	18 3	16 3
East Rand Consolidated (5s.)	2 3	2 0
Free State Development (5s.)	6 9	6 9
General Exploration O.F.S. (2s. 6d.)	4 3	4 0
General Mining and Finance	5 11 3	5 7 6
Henderson (4s.)	2 12 6	2 12 9
Johannesburg Consolidated	4 9	4 6
London & Rhod. M. & L. (5s.)	11 9	12 0
London Tin Corporation (4s.)	16 0	16 0
Lydenburg Est. (5s.)	3 3	2 9
Marsman Investments (10s.)	2 6	2 0
National Mining	4 13 9	4 11 3
Rand Mines (5s.)	2 15 6	3 0 9
Rand Selection (5s.)	2 16 0	2 17 0
Rhodesian Anglo American (10s.)	2 3	2 3
Rhodesian Corporation (5s.)	9 6	9 3
Rhodesian Selection Trust (5s.)	1 14 3	1 11 0
Rio Tinto (10s.)	4 11 3	4 6 0
Selection Trust (10s.)	10 0	10 0
South West Africa Co. (3s. 4d.)	3 4 6	3 5 6
Union Corporation (2s. 6d.)	5 3 0	5 7 6
Vereeniging	3 0 3	2 17 6
West Rand Inv. Trust (10s.)		

# THE MINING DIGEST

## A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

*In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.*

### Stability of Slimes Dams

In a paper appearing in the *Journal of the South African Institute of Mining and Metallurgy* for October G. W. Donaldson reviews "The Stability of Slimes Dams in the Gold Mining Industry." In his introduction he says that the gold-mining industry has been faced with the problem of the disposal of tailings since its inception and as the tonnage milled has increased the problem has become more acute. To-day, with large tonnages milled and use of the all-slimes process, a considerable amount of money, time, and effort is devoted to the disposal of finely-ground tailings, known locally as slimes. As the mining industry has developed the methods of construction of slimes dams have gradually evolved until a practical method of disposing of slimes has been found. On many of the larger mines over 100,000 tons of slimes are deposited per month and dams of several square miles in area are not uncommon. However, the author goes on to say, although most slimes dams give very little trouble, there have been some major failures and numerous minor break-aways. The existing methods of building slimes dams have been evolved on the basis of experience gained by trial and error and there has been no real scientific basis for their design. It was for this reason that the Transvaal and Orange Free State Chamber of Mines sponsored an investigation into the stability of slimes dams which was carried out by the National Building Research Institute during the period 1953 to 1959.

The slimes consists mainly of finely-ground quartz particles, most of the particles being below 0.1 mm. The aim of slimes dam construction is to place tailings in a specified place and to retain them there indefinitely. This is achieved by constructing walls, of the material itself, to enclose an area which contains the remainder of the waste material, excess water and rain water accumulating on the top of the dam. The water level in the dam is controlled by means of a penstock intake level. The most important parts of the dam as far as durability and stability are concerned are the outer walls.

The criterion of failure for a slimes dam can be broadly defined as the removal of material from the position in which it was originally placed in the outer walls in such quantities as to cause concern. Serious breakages may affect the operation of the dam and thus affect the whole mine. Wind erosion may cause a dust nuisance without giving cause for concern in regard to stability. However, material washed off or out of the dam may pollute streams.

Failures can be divided into three types according to different causes as follows:

(a) *Surface Erosion.*—Material is removed from the outer surface of the dam wall by rainfall run-off and wind erosion. This is clearly shown by the formation of gullies on the outer slopes.

(b) *Seepage Problems.*—Water which has collected in the pool round the penstock on top of the dam seeps through the wall and emerges at the toe of the wall, causing "weeping" and under-cutting of the walls.

(c) *Shear Failure or "Breakaways."*—These occur when the shear strength of the slimes material or of the foundation soil is too low, with the result that a large portion of the walls tears away and slides out on to the adjoining ground. In some cases the material liquefies and flows out.

The author then goes on to review each type of failure and, finally, to give the following summary of recommendations. He points out that the stability of any particular slimes dam is dependent on a combination of various factors. As the range of combinations is very wide it is impossible to draw up a hard and fast set of design rules. For the same reason no hard and fast limits can be set on the height or rate of building for slimes dams in general, as dams would have to be analysed individually in the light of the special conditions obtaining at each dam. Bearing this in mind it is felt that the greatest benefit will be derived from the research by carrying out the following recommended procedures:—

#### *To Prevent Surface Erosion.*

(1) Where possible it is desirable that the pyrites content of the slimes should be maintained above about 0.7% to ensure the formation of a hard crust.

(2) The possibility of planting vegetation to protect the slopes should be explored.

(3) Gullies should be stopped before they become too large. Erosion should be checked before it is too severe.

#### *To Prevent Seepage Erosion*

(1) Before building a new dam a survey should be carried out to determine the drainage conditions of the dam site including permeabilities, depth to water table, and related drainage features.

(2) If the drainage conditions on the site vary the penstock should be located over a well-drained area.

(3) If the location of penstocks over areas where the drainage is inadequate cannot be avoided it will be necessary to provide improved drainage to control the seepage water by an appropriate system of drains.

(4) The extent of seepage flow should be reduced by keeping the water-level in the pond as low as possible.

(5) Water should be removed from the wall areas of the dam as soon as possible.

(6) Existing walls with seepage problems should be reinforced by the addition of under-drained buttresses.

#### To Prevent Shear Failure

(1) In all stability analyses the worst conditions likely to occur during the life of the dam must be established and used for the stability analysis.

(2) A site investigation should be carried out before the building of a slimes dam to determine the shear strength of the foundation soil. Trial boreholes should be drilled to a depth at least equal to the proposed ultimate height of the dam unless satisfactory solid material is encountered at a shallower depth. Such shear strength data will allow the dam to be designed to prevent failure through the foundation soil.

(3) In cases where the combination of factors is very complex or where a more accurate design is required the services of an expert soil mechanics engineer may be required and the following design criteria will have to be used:—

(a) In the absence of any other information slimes should be treated as a purely frictional material with an angle of internal friction of  $35^\circ$  and the maximum permissible slopes of walls calculated on this basis.

(b) If allowance is to be made for the added strength due to over-consolidation relationships

between shear strength, slope, and factor of safety should be established.

(c) In order to determine satisfactory wall width the positions of the worst failure arcs must be known.

(4) It can be stated that a wall width of 250 ft. will, in general, be sufficient to ensure that failure will not occur through weaker material deposited within the basin of the dam.

(5) In order to obtain the maximum shear strength from the material it should be kept as dry as possible and all seepage flow should be eliminated.

(6) Where the design of a new slimes dam is based on the prediction that over consolidation will occur and give increased shear strengths *in situ* tests should be carried out periodically to ensure that the design strengths are being obtained. If the practical conditions are not the same as those predicted in the design stage the design will have to be modified.

(7) It is suggested from experience that no more than a 2-in layer of solid slimes should be deposited at a time and that two weeks or longer should elapse between consecutive depositions of slimes.

(8) It is further suggested that slimes dams be worked in sections so that after a period of several months of deposition the wall area will be "rested" for several months to allow thorough desiccation to occur.

(9) Existing dams showing signs of distress should be treated by the addition of a low under-drained buttress which will have the effect of reducing the overall slope.

## New Coal Plant in South Wales

Some notes issued last month by the General Electric Company's Engineering Group cover the design and construction of what is described as a £1 million coal preparation and dirt crushing plant at the Cynheidre colliery, near Llanelly, in the South Wales Division of the National Coal Board. The new plant, officially opened recently, has resulted in the closing of at least part of the surface plants at nearby Crosshands, Great Mountain, and Blaenhirwaun collieries, but is expected when up to maximum capacity to contribute greatly to the streamlining of the industry.

The plant operates on the two-process principle and has a maximum capacity of 400 t.p.h. A complicated dirt-crushing plant with a capacity of 120 t.p.h. can feed dirt back to the pithead for underground stowage or to a bunker for ultimate disposal on a refuse tip. As part of the contract a 24½-ton capacity side-discharge wagon tippler has been supplied.

From the pithead run of mine coal is discharged on to a conveyor system, fitted with automatic weighing equipment, feeding raw coal into the wagon tippler hopper. Coal is extracted from the hopper at a uniform rate of 400 t.p.h. by means of a Sherwen vibrating feeder and directed on to a belt feeding No. 1 primary raw coal screen which is of the shaker type. This double-deck screen separates the material into three sizes—plus 6-in., 6-in. by 3-in., and minus 3-in.

The minus 3-in. fraction is conveyed direct to the two secondary raw coal screens, while the 6 in. by 3 in. is fed into a Pegson "Gyrasphere" set to

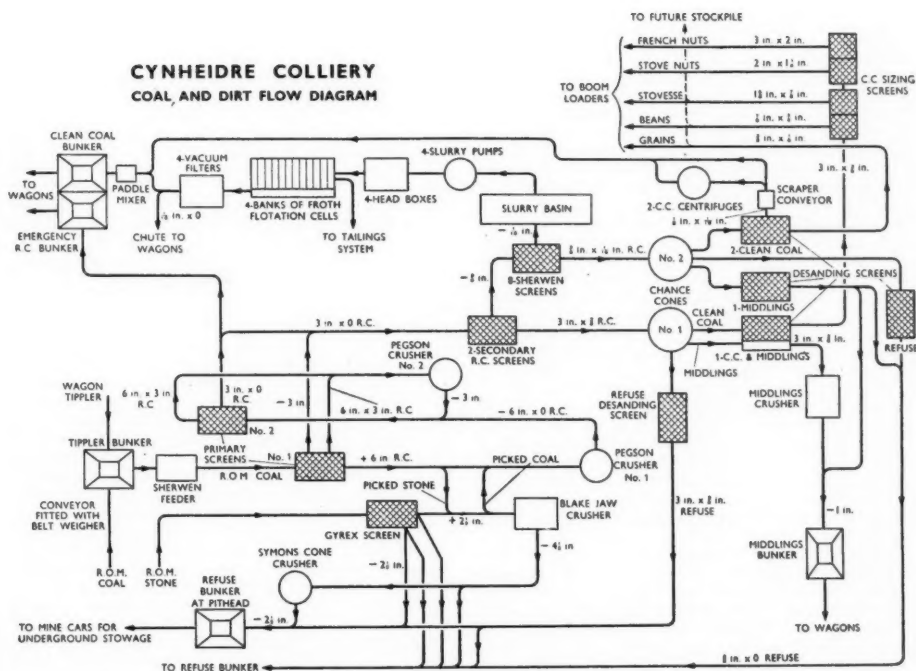
reduce the product to minus 3 in. Meanwhile the plus 6 in. from the primary raw coal screen is discharged onto a 48 in. wide picking belt where, after removal of tramp iron, it is reduced to minus 6 in. by a Pegson gyratory crusher. The products from both crushers are then directed to No. 2 primary raw coal screen, fitted with a 3-in. diameter mesh, the "throughs" passing by conveyors to the two secondary raw coal screens and the oversize being directed through the Gyrasphere. Small pieces of tramp iron are prevented from entering the washery by a 65-in. diameter Witton-Kramer magnet suspended over the conveyor leading to the secondary raw coal screens.

Provision has been made in the conveyor system feeding the secondary raw coal screens for the minus 3-in. raw coal to be diverted into an emergency bunker in the event of a stoppage in the washery.

Two secondary raw coal screens of the shaker type are installed, fitted with ¾-in. diameter perforated plate. The oversize from these screens, 3-in. by ¾-in., is conveyed to No. 1 Chance cone and the throughs are laundered to a battery of eight Sherwen vibrating screens fitted with ¾-in. square mesh, from which ¾ in. by ¾ in. is discharged into No. 2 Chance cone, while the throughs flow to the slurry basin. Part of the spraying and laundering water used on the screens is taken from the effluent pit, so economizing in the use of clarified water.

The two 12-ft. diameter Chance cones thus deal with different sizes of raw coal, each cone being arranged for a three-product separation—namely,

# CYNHEIDRE COLLIERY COAL AND DIRT FLOW DIAGRAM



## The Maranboy Tinfield, Northern Territory

The "Exploration of the Maranboy Tinfield" is reviewed by J. Shepherd in the *Mining and Chemical Engineering Review*, of Melbourne, for September 15. The author describes work carried out by United Uranium N.L. under an Authority to Prospect over 16 sq. miles of territory surrounding the Main Lode and the Stannum King line. The Main Lode, he says, is situated on the north-east flank of a south-east-pitching anticline. The country rocks outcrop poorly and do not show structures well, though bedding is frequently well-marked in unweathered drill core. Enough outcrop evidence offers to show the divergence of the rock strike from the trend of the lode (about 35°).

Predominant rocks are Lower Proterozoic in age, and consist of siltstones, sandstones, shales, and hornfels, and most are almost certainly of tuffaceous origin. Greisenized granite with much tourmaline and some tin mineralization intrudes the Lower Proterozoic series. The granites and the Lower Proterozoic sediments are overlain by a flat-lying Cretaceous series. The extensive tourmalinization and hornfelsing of the sediments make it probable that granite underlies the whole of the Maranboy area but it is impossible to say at what depth.

There are three main fault directions: 310°, 30°, and 90°. Mineralized lodes occupy the first set which is the trend of the Main and Stannum King lodes. These lodes occupy the earliest of the fault channels and are cut by the other two groups which therefore present mining problems.

The lode is a dense, hard, fine-grained siliceous rock, dark grey in colour from the presence of abundant fine tourmaline. There is microscope evidence that two generations of tin are present and this may be related to two stages of movement in the Main Lode channel. Late tin occurs in cross-cutting veinlets and is coarse grained.

The extremely fine state of division of much of the cassiterite and its strong sliming characteristics have posed a metallurgical problem. Research would be necessary to improve the recovery by gravity concentration of 60% to 65%. Yellow earthy bismutite occurs in some places and is generally a favourable indicator. The Main Lode occupies a channel which strongly transgresses regional structures. At the surface the hanging-wall contact is commonly more strongly defined and a selvage of heavily-brecciated quartz is frequently present. At the foot-wall side, however, the contact of the lode is gradational and conformable and in many underground exposures it is difficult to decide whether to map as lode or as country rock. Replacement and metasomatism have played a great part in this environment.

This contrast is apparent throughout the field. There are innumerable small lodes inter-bedded with the sediments and some contain fine-grained cassiterite and have been worked by gougers. However, many such lodes are barren. Because of the small size and scattered occurrence of these bedded lodes they have little commercial significance. The fine-grained ore, pneumatolytically produced by emanations from the granite, is widespread through the district and contributed a substantial portion of the cassiterite present in the Main Lode. A later generation of mineralization characterized

by coarser grain size and probably related to renewed movement on the Main Lode fault raised the metal content to a grade which gave promise of a substantial ore-body and justified a detailed investigation. Though separated in time the two waves of mineralization may have been penecontemporaneous.

Several hypotheses are examined to account for the diminution of grade at depth:—

(1) Surface supergene enrichment. In view of the fine-grained chemically-inert nature of the lode, the prevailing low relief, and the unweathered appearance of the tin-bearing hornfels this hypothesis is regarded as untenable.

(2) Vertical zoning due to the distribution of layers of favourable country rock type about the lode. In shaft sinking and underground exploration no evidence to support this was seen.

(3) A locus of "best-ore deposition" is likely to occur at a fixed distance from the underlying granites and the present Main Lode workings may occur where erosion has exposed the favourable zone. The application of geophysics would help further investigation of these problems.

(4) The most feasible theory to account for the concentration of values near the surface is to relate the present ore layer to the unconformity between the Cretaceous rocks and the underlying Lower Proterozoic. An hypothesis of damming of ore emanations against an overlying blanket is the most straightforward theory and is supported by some field evidence; though not enough data has been collected to decide the matter finally. The validity of the theory could be tested by an examination of the Cosmopolitan Lode where the blanket rocks have been denuded in only a few places.

This hypothesis, if it is valid, does not offer much hope for the future of the field. It is certain that the degree of stripping of the cover of the Cretaceous rocks in the Main Lode area is not very great and even if the present ore represents the roots of an original deposit the vertical extent of ore would have been too limited to provide substantial tonnages. It is believed that the Main Lode line is the yardstick by which potentiality of the field should be measured.

The following factors revealed by the company investigation make it seem unlikely that a profitable operation could develop even if considerable expenditure on exploration and capital works was undertaken:

- (1) Run-of-mine ore too low grade.
- (2) Weakening of grade with depth.
- (3) Ore widths generally less than expected.
- (4) Lode areas between ore-shoots completely barren.
- (5) Few high-grade patches.
- (6) Treatment difficulties.
- (7) Incomplete understanding of ore localizing controls.

Drilling by the Bureau of Mineral Resources has indicated a tonnage of marginal grade ore which could constitute a strategic reserve in times of emergency, but under present conditions it is unlikely that the prospect would attract a mining company.

## Trade Paragraphs

**Cementation Co., Ltd.**, of 20 Albert Embankment, London, S.E. 11, announce that a branch of the Cementation Group has been established in Australia. Operating initially from Melbourne, it will concentrate on all aspects of foundation engineering including piling, anchor stressing, exploratory drilling, grouting, and the application of Cementation and allied geotechnical processes.

**Saunders Valve Co., Ltd.**, of Cymbran, Mon., point out that in the note which appeared last month there was some confusion between two new products—the rubber-lined non-return valve and the solid p.t.f.e. valve—and the company's power-operated valves for remote control. The new products are, in fact, the non-return valve, which is automatic in action with simple flap construction, and the p.t.f.e. valve, in its present form handwheel controlled and in small sizes only ( $\frac{1}{4}$  in. and  $\frac{1}{2}$  in.).

**Joy-Sullivan, Ltd.**, of Greenock, announce the provision of sales, spares, and servicing facilities for the Joy-Hazemag impact crusher, manufactured by the Hazemag m.b.h. of Munster, Westphalia, Germany. Manufacture of spare parts will commence immediately in this country and in the near future the complete units will be made here. The salt and potash mining industries will find the crusher of particular value because it provides primary and secondary crushing in one operation, selective separation of rock salt and anhydrite, and grain-preserving grinding to the fineness required for subsequent flotation. Applied to ore mining the Joy-Hazemag offers selective preparation of mineral-bearing tailings and, in many cases, elimination of intermediate stages of crushing.

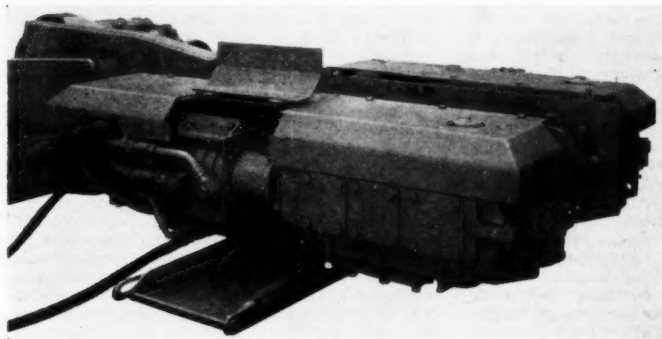
**Saxon Engineering Co., Ltd.**, of Fenton, Stoke-on-Trent, have recently developed a vibratory screen, which has many new design features the most important being the resilient mounting of the entire screen body in bonded rubber bushes. Sizes up to 10 ft. by 4 ft. are available with a maximum power requirement of 3 h.p. The amplitude of vibration is variable and, where required, models can be supplied arranged for double-deck screening and also for mobility. For dealing with fine materials where the moisture content could cause blinding the screen is readily adapted for thermal deck heating. This type of screen is already in use in the ceramic industry effectively handling fine clay with a moisture content of 10%. For certain

requirements of the chemical industry the screens are made in stainless steel.

**Richard Sutcliffe, Ltd.**, of Horbury, Wakefield, issue some notes on the hydraulic Armadillo as illustrated. After reference to the application of hydraulic drive to conveyors in preference to compressed air there follows a short explanation of the principles. When applied to the Armadillo the result is that the machine is very much smaller in size and requires only 35 sq. ft. of floor area compared with 56.5 sq. ft. for the air-driven machine. This means that the prop setting can be much closer (5 ft. 4 in. compared with 6 ft. 4 in. when a compressed-air drive is used). Stopping time is also greatly reduced. The hydraulically driven Armadillo will stop within 2 ft. of travel. The machine is quiet in operation and there are no exhaust vapours. The hydraulically driven machine affords the same degree of visibility as can be expected from electric motors.

**Baker Perkins, Ltd.**, of Peterborough, issue particulars of the Baker-Meyer mill—a single roller unit suitable for grinding clays, natural earths, carbons, and coke developed by Neuman and Esser, of Aachen, and available in five sizes. One of the novel characteristics of the machine is the use of a hydraulic ram to apply pressure between the roller and the bull ring. This is done in such a way that roller bounce is eliminated, adjustment between the roller and the ring for different types of material can easily be made, and automatic compensation is achieved when wear takes place. Hot gases at temperatures of up to 550° C. can be used for drying during grinding. Crude materials containing as much as 25% moisture can be ground without difficulty. The introduction of the hot gas into the system above the mill permits operation at normal (and economical) temperatures. Other materials which can be handled include: Barytes, limestone, phosphate rock, manganese ore, talk, feldspar, kaolin, and graphite.

**Deister Concentrator Co., Inc.**, of Fort Wayne, Indiana, have issued a leaflet describing their Model E vibrating screen with FlexElex screen heater. This is the Leahy heavy-duty screen which provides a differential motion to keep the meshes clear of intermediate-size wedging particles and a heater to keep the screen wires warm and dry for the high production that results from no blinding.



**Sutcliffe  
Hydraulic  
Armadillo.**

Case  
"1000"  
Shovel.



Some other improvements include:—An entirely new jacket assembly and mounting concept. Simplified jacket tensioning adjustment for uniform tautness and effective overall vibration. Easy and quick mounting and demounting of jackets. No electrical connexions to unmake and remake when changing jackets. Bus bar runs from heating transformer to contact bars at jack are short and direct, out of the way, and scarcely in evidence. Bus bars are of generous cross-section in laminated assembly with air gap spacing. Elimination of flexible cables or connexions in the heating circuit.

**Elcontrol, Ltd.**, of Wilbury Way, Hitchin, Herts., have issued some further notes on automatic weight-control equipment and refer to a new range of equipment designed for use in industry involving control of plants handling bulk materials such as ores. The new Elcontrol type LC4 trip-point controller and LC5 trip-point controller *plus* margin indicator have been designed to give reliable control under the most arduous conditions. These are robustly constructed and compact. The load cells can be safely used in very wet conditions or even submerged and flameproof and intrinsically safe equipment can be supplied as standard. The units are primarily controllers and the control is actuated directly *via* the amplifier. The control function is therefore not dependent on the operation of a vulnerable instrument system. No mechanical accessories are used in the indicators and in this way any failure of the moving-coil type instrument does not cause failure.

**J. I. Case Co., Ltd.**, of Mill Road, West Drayton, Middx. (subsidiary of J. I. Case Co., of Racine, U.S.A.), refer in a recent note to the Case crawler range currently offered in the United Kingdom. This includes the "800" shovel (20,700 lb. drawbar pull—1½ cu. yd. standard bucket capacity), the "1,000" shovel (25,400 lb. drawbar pull—2 cu. yd. standard bucket capacity), and the "1,000" hydraulically angling or tilting 'dozers. These machines are distinguished by their system of "Terramatic" drive which is a fusion of torque converter and constant-mesh gear train and gives

independent control to each track. The range of wheeled loaders comprises shovels from 1 cu. yd. to 2½ cu. yd. standard bucket capacities and powers from 57 h.p. to 120 h.p. All these are also equipped with torque converter, power shuttle transmission, and power steering. The photograph shows the "1,000" shovel with hydraulically operated ripper ripping up the floor of a limestone quarry.

**Mitchell Engineering Group, Ltd.**, of 1 Bedford Square, London, W.C.1, have been awarded a contract valued at approximately £440,000 for the construction of a coal-preparation plant at Blidworth Colliery, Notts., designed to clean run-of-mine coal from the "Top Hard" and "Hazel" seams at a maximum rate of 400 t.p.h. The coals will be screened at either 8 in. or 6 in. and the oversize material will be hand sorted on a rotary picking table where the products made will be rejected stone, two qualities of + 8 in. or + 6 in.—*i.e.*, Hard and Brights—and middlings.

The large coal will be loaded directly into railway wagons *via* loading booms. The large hand-picked middlings will be crushed and mixed with the coal passing through the primary screen. The coal below 8 in. or 6 in. will be screened at 1 in. and the + 1 in. material, separated in Ridley-Scholes dense-medium primary and secondary baths, yielding clean coal, middlings, and dirt. The "Top Hard" and "Hazel" coals will be washed separately; the coal below 1 in. in size will be washed in Baum jig washers.

**Johnson, Matthey and Co., Ltd.**, of Hatton Garden, London, E.C.1, announce that they are now producing very pure arsenic, antimony, tellurium, and bismuth on a commercial scale. By means of newly-developed techniques arsenic is being produced with an impurity level of the order of 1 p.p.m., detected by use of present known and accepted spectrographic methods. The element is in the form of crystalline lumps and is packed in vacuum-sealed glass tubes.

Antimony with a maximum metallic impurity content of 5 p.p.m., and bismuth with a maximum level of metallic impurities of 10 p.p.m., are being produced in ingot form. Zone-refined tellurium with

a metallic impurity content of the order of 1 p.p.m. is also available in bulk in the forms of ingot or grain. The company point out that because of the increasing importance to the semiconductor industry these four high-purity metals find growing application in the form of inter-metallic compounds. For example, gallium arsenide is used in the production of special diodes and transistors, indium antimonide and indium arsenide are used for magneto-sensitive devices, and bismuth telluride is used in Peltier cooling units.

**Morgan Crucible Co., Ltd.**, of Battersea Church Road, London, S.W. 11, and **British Belting and Asbestos, Ltd.**, have registered a new company named Morgan-Mintex, Ltd., which will manufacture sintered friction materials, sold under the registered trade mark "SINTERLINK." These materials have been developed by the Morgan Crucible Co., Ltd., and are produced at their factory in Wandsworth, where the new company will be located. Sales throughout the world will be handled by the Mintex Division of British Belting and Asbestos as sole concessionaires. SINTERLINK sintered friction materials will add to the existing range of friction materials offered by Mintex, which are mostly based on the combination of asbestos fibres with natural and synthetic resins; together they will offer a very considerable variety of physical properties, sizes, and shapes. SINTERLINK has distinctive qualities which are complementary to those of "MINTEX" materials and are of especial value in automatic transmissions, and heavy earth-moving equipment where its physical and mechanical properties and better heat dissipation characteristic permit higher unit loadings, resulting in more compact designs.

**Sandvik Steel Works Co., Ltd.**, Sandviken, Sweden, last month opened a new factory for the production of rock-drilling equipment, mainly of detachable bits and extension steels of over 1½ in. diameter. The biggest detachable bits which will be made will be 9 in. in diameter. Each of these weighs 132 lb. including the tungsten carbide insert, which itself weighs 17½ lb. (These figures form an intriguing contrast to one of the smallest Sandvik products, a plughole drillsteel, 0.3 in. in diameter and weighing only a few ounces.) Steels for the new drills have been developed since the war in conjunction with **Atlas Copco AB**, of Stockholm, who now have the selling rights for Sandvik Coromant drillsteels throughout the world outside Scandinavia. All the Sandvik hard metal is manufactured at the company's factory. It is a sintered product consisting of approximately 90% tungsten carbide, 10% cobalt, and small proportions of other materials. At the opening ceremony Mr. Wilhelm Haglund, the managing director, pointed out that the new factory is not the only example of the company's expansion. Of recent months Sandvik have built extensions to their electro-steel works, a warehouse for tubes, and enlargements of their Coromant tool factory.

**Frederick Parker, Ltd.**, of Leicester, have introduced two new models to their range of "Sandor" sand dewaterers. The "Sandor" consists of a tank into which sand and water are fed and where the sand is allowed to settle. Special perforated buckets on legs attached to a strong rubber and canvas belt move slowly through the settled sand and travel upwards through comparatively calm clean water. The mounting of the dredger buckets allows the water to drain off immediately they leave the water



in the tank on their upward path to storage. The first of the new models has 36-in. wide buckets, a tank with a capacity of 50,000 gal., and an output of about 70 t.p.h. The second model designed to recover a high proportion of extreme fines has in addition to the 50,000-gal. main tank a supplementary tank. The fines which settle in the supplementary tank are returned to the main tank by a spiral worm. In this model 30-in. wide buckets are used. The output is 50 t.p.h. Both models are powered by a 12½-h.p. motor through a 60:1 gearbox and final chain drive.

**Cooper and Turner, Ltd.**, of Vulcan Road, Sheffield, make available some notes on armoured flexible conveyor production at the wagon works of the Butterley Co., Ltd. The conveyor exists in a number of sizes, a typical conveyor however consisting of a number of sections 2 ft. wide and 4 ft. 11 in. long fabricated from ¾-in. abrasion-resistant plate. These sections or pans take the general form of a flat tray with flanged side pieces which enable a chain ladder of high-tensile steel chain and scraper bars to be drawn through a number of joined sections returning by flanges on the underside of the pan, the flanged side pieces being special rolled sections. Each section of the conveyor is joined to a preceding section by loosely-bolted mating lugs and sockets which are welded to the side pieces and these sockets are shaped to allow for movement within the limits of 4° in any direction so that the conveyor can be "snaked". The side pieces are also mated by half-discs and milled quadrants, two discs being welded into recesses at one end of each side piece such that they engage

smoothly in the recesses of the adjoining members. The main plate of each pan is extended and stopped at the receiving end to fit underneath the adjacent section, thus giving an overlap to prevent spillage at the joint. Each section is provided with eight spill plate brackets to accommodate four spill plates. The conveyor is driven by a 40 to 50 h.p. motor at 1,460 r.p.m. through a gearbox and fluid coupling.

**Head Wrightson and Co., Ltd.**, of 20, Buckingham Gate, London, S.W. 1, in a recent statement record that their subsidiary, Head Wrightson Stockton Forge, Ltd., has changed its name to Head Wrightson Stockton, Ltd. This move was considered expedient in view of the greater diversification of activity since the days of the company's formation over 60 years ago and the extension of their operations into new industries. To-day the company designs and manufactures specialist equipment for the mining, iron and steel, chemical, and allied industries. The company's services in the constructional field including light-alloy structures, vessels, bridges, tanks, etc., are used extensively overseas.

Another company is the subject of a separate statement. Head Wrightson Iron and Steel Works Engineering Ltd. have received an order from Appleby-Frodingham Steel Co. (branch of the United Steel Companies, Ltd.) for the design and construction of further extensions to their ore preparation and sinter plants covering the supply of four additional sinter machines 8 ft. wide by 168 ft. long together with the engineering of the complete plant.

The company have also produced an illustrated leaflet on the subject of pelletizing which refers to the work of their research and development department for dealing with a wide range of problems in the mineral processing field. Here there is a pilot plant for tests on pelletizing and granulating. As an example of application, when finely divided ores—e.g., flotation concentrates—are suitable for feeding to a sintering machine the mixture is passed through a pelletizing drum to give a granular and therefore more permeable bed.

**Holman Bros., Ltd.**, of Camborne, refer in a recent note to the new factory for Holman-Iberica S.A. recently opened at Pinto, near Madrid, by Mr. P. M. Holman. The Spanish company was formed in 1957 by Holmans with their agents, Maclaurin Morrison y Cia S.A. and the latter company's associates the Siberex Group. Initial production was concentrated on air-compressors; the first, with a capacity of 120 c.f.m. and powered by a Barreiros diesel engine of wholly Spanish manufacture was completed in July last year. While built from drawings and patterns supplied from Camborne all components except the valve assemblies were manufactured in Spain. Additionally the manufacture of stationary compressors, Holsteels, Holbits, and rock-drill spares is already under way. A larger capacity compressor, a range of pneumatic tools and the Silver Three Handril are all scheduled for production.

A more recent note calls attention to a new Portuguese record for rock tunnelling in the Cavado Rabagao tunnel of the Alto Rabagao Hydro-Electric scheme (Hydro-Elctrica de Cavado) Portugal. This tunnel, which is one of many in the scheme, will have a final length of 4,900 m. of which 2,100 m. have been completed. The tunnel is 4.01 m. by 3.96 m. (13 ft. by 13 ft.) of horse-shoe in hard granite. All drilling was done with Holman

Silver Three Handrils mounted on Holman 52 in. Airlegs. Three worked from invert level with three more on a rail-mounted portable staging to deal with the upper section. Air pressure at the face was 5.5 to 6 kgs./cm.<sup>2</sup> Ten men were employed at the face during each eight hour shift. A vee cut employed called for an average of 56 holes per round, each 3.2 m. deep. Three rounds were drilled every 24 hours, but it is felt that this rate of progress could be increased by improving the mucking arrangements.

**International Combustion, Ltd.**, of 19 Woburn Place, London, W.C. 1, issue some notes on Raymond flash drying systems, which are used to remove definite amounts of moisture from damp granular or fibrous material. The material is circulated in a hot turbulent gas stream, causing the rapid transfer of heat and evaporation of moisture. When simultaneous drying and grinding is required a disintegrator or pulveriser is included in the system. The finished product is separated, cooled, and conveyed in a dust-free plant operating under suction and its dryness and particle size may be accurately controlled. Hot gas is supplied either by direct firing, indirect heating, or the use of waste gas and International Combustion furnaces operating on gas, oil, or coal, and heat exchangers are provided to meet these conditions. Several wet feeder arrangements are available, allowing the rate of feed to be changed as required. The mixer is used to condition the incoming wet feed by blending it with previously dried material. A product is thus obtained which can be easily picked up by the hot gas stream. A cage or impact mill is incorporated in the system when simultaneous drying and grinding is required. Wet material is fed into the hot gas stream and the mixture then enters the mill axially. The product leaves the mill almost completely dried but mixed with the gas. After passing through the uptake pipe this mixture enters a cyclone collector, where separation occurs, and the moisture-laden gas is discharged to atmosphere through the vent fan. A bag filter, cyclone, or wet scrubber are sometimes included in the system after the exhaust fan. The dry divider proportions the finished product when dry return is needed for conditioning the incoming wet feed. This proportioning device may be either manually or automatically controlled.

## Public Works and Municipal Services Congress and Exhibition

Continuing the notes which appeared in the November issue particulars are given in the following of some further items of interest seen at the exhibition.

**A.E.C., Ltd.**, of Southall, Middx., occupied two stands. On one of these the largest in their range of Dump trucks—an 18-cu. yd. capacity machine—was exhibited. This is equipped with the A.E.C. turbo-charged diesel engine which develops 340 b.h.p. at 1,900 r.p.m. This engine and others in the company's range were also shown.

**Atlas Copco (Great Britain), Ltd.**, of Hemel Hempstead, Herts., displayed a range of compressors and pneumatic tools. Foremost among the rock-drills on the stand were the Lion and Tiger models which are the same type as the drill now being used

to drive the Mont Blanc road tunnel from Italy to France and the Loch Awe hydro-electric tunnel in Scotland. Also on view was the record-breaking rock-drill the BM31 benchner. Recently, when working in granite at a site in Sweden, one man drilled a total of 750 ft. in one shift with two drills of this type. The BM31 is the most economical drill to use on projects where wagon drills would be uneconomic. It weighs 89 lb., has an effective feed length of 70½ in., and is mainly intended for drilling with integral steels with changes of 5 ft. 3 in.

**E. Boydell and Co., Ltd.**, of Old Trafford, Manchester, in addition to the items mentioned in the note in November were also showing for the first time the Muir-Hill Camill 7-cu. yd. dumper—an articulated dump truck with Fordson diesel engine of 58 b.h.p. at 1,600 r.p.m.

**Craelius Co., Ltd.**, of 11 Clarges Street, London, W. 1., showed the XCH-60 diamond drill, skid mounted and equipped with a Ruston 2 YWA diesel and the XF-90H medium-capacity drill rated to 2,000 ft. for rods up to 3½ in. diameter. The X25, a light air-driven drill suitable for underground work was also shown, together with a number of drilling accessories.

**Dowty Hydraulic Units, Ltd.**, of Ashchurch, Glos., indicated in their display a variety of applications of their hydraulic equipment to earth-moving machinery and rail transport, examples including a Massey Ferguson tractor-digger-shovel with Dowty gear pump, control valves, rotary retractor, screens, and self-sealing couplings, a mine locomotive by Ruston and Hornsby of 48 h.p. with Dowmatic transmission, and Aveling Barford dumpers equipped with hydraulic tipping and steering.

**Griffin and George, Ltd.**, of Ealing Road, Alperton, Wembley, Middx., demonstrated a site testing laboratory in which are samples taken from a

number of sub-strata by means of the equipment. Wall displays showed clay sampling in progress, general site investigations, and sites where failures due to subsidence and other factors have occurred.

**Hadfields, Ltd.**, of Sheffield, had one of their 36 in. by 24 in. double-toggle jawbreakers on show fitted with mechanical grease lubrication and a working model of a 72 in. by 48 in. machine. Attention was also called to dragline and dipper buckets, of which 5 cu. yd., 3 cu. yd., and ¾ cu. yd. examples were exhibited. Various castings for crushing and earth-moving equipment were included in the display.

**Holman Bros., Ltd.**, of Camborne, in addition to the items mentioned in the note in November showed for the first time the Holtrac (as illustrated) a powerful crawler-mounted drill rig which with a towed air-compressor forms a self-propelled unit capable of being operated by one man. It carries a SL 160 heavy drifter. Maximum track oscillation over all types of ground by means of an articulated action system ensures stability and manoeuvrability under adverse site and quarry conditions.

**Robert Hudson, Ltd.**, of Meadow Lane, Leeds, were showing their Ruga wagon such as is made in sizes from 1½ cu. ft. to 54 cu. ft. capacities and usually for 2-ft. gauge trucks and called attention to diesel locomotives by the Hunslet Engine Co., Ltd., for whom they are agents.

**Joy-Sullivan, Ltd.**, Air-Power Division of 7 Harley Street, London, W. 1., were showing the "Airvane" RP. 365 rotary portable and the WN.112 industrial heavy-duty stationary compressors. A feature of the RP. 365 is the "built-in" multiple safety circuit which automatically shuts off the engine in the event of rising temperature, falling engine oil pressure, or excessive temperature of discharge air. Examples of the range of rock-drills were also on display. The JAL.47 drill shown is basically the hand-held model L.47 adapted for mounting on an automatically retractable airleg of a special material construction with a high strength to weight ratio.

**Merton Engineering Co., Ltd.**, of Faggs Road, Feltham, Middx., in addition to their own products referred to in the note in November were showing for the first time the Nelson tractor shovel, model 200D—a product of N.P. Nelson Iron Works, of New Jersey. It is powered by a 105-h.p. diesel engine and has, as standard equipment, a 2½ cu. yd. rated capacity bucket capable of lifting a 13,000 lb. load. The bucket has 40° crowd at ground level and a discharge angle at maximum height of 50°. Maximum clear discharge height is 9 ft. 6 in. with a forward reach at this height of 2 ft. 2 in. Power is transmitted to the driving axles by an Allison Torqmatic transmission consisting of a torque converter and planetary and transfer gears, all clutches being hydraulically operated.

**Mining Engineering Co., Ltd.**, of Worcester, demonstrated by means of a quarter-scale model their belt-conveyor telescopic unit and radial spreader designed for spoil disposal. Advancing of the spreader can be effected while the conveyor system is running. A standard section of belt-conveyor structure of the suspended idler type was also shown together with a length of Mecotube as used in mine and tunnel ventilation.

**Mono Pumps, Ltd.**, of 1 Sekforde Street, London, E.C. 1, had a display of several pumps suitable for handling sludge and liquids containing small solids. Working models demonstrated the simple construction.



The Holtrac Drill Rig

**Nordberg Manufacturing Co.**, of 19 Curzon Street, London, W. 1., had as principal exhibit a 3-ft. standard Symons cone-crusher arranged so that the crushing action could be inspected. A range of bar and rod screens and the horizontal F type screen were also to be seen in operation.

**Padley and Venables, Ltd.**, of Clutha House, 10, Storey's Gate, London, S.W. 1., on the rock-drilling section of their stand featured deep-hole drilling equipment, coupled rods, heavy-duty percussive bits, and external meter feed attachments as well as examples from the range of tungsten carbide-tipped drill stems and detachable bits for both percussive and rotary tools that they supply.

**Frederick Parker, Ltd.**, of Leicester, made a feature of the Cascade scrubber-mill or washer. The complete mobile unit shown was a composition of three standard units—the Scrubber-mill, the "Rapide" vibrating screen, and the "Sandowheel" sand dewaterer, each of which can be used or mounted separately. The construction of the Scrubber-mill is such that the cylinder is always heavily loaded regardless of the rate of feed, the period of time which sand, gravel, or stone spends in the mill being determined by the feed rate. For example, at a feed of 30 t.p.h. the material will be scrubbed and milled for about five minutes, but at 60 t.p.h. it will be about half this time.

**Pegson, Ltd.**, of Coalville, Leicester, showed two typical crushing machines from their range—a 48 in. by 36 in. double-toggle primary jaw-crusher and a new secondary crusher, the 66-in. Gyrasphere.

**Perkins Engines, Ltd.**, of Peterborough, in a further note on their part in the exhibition call attention to an exhibit by the **Rolla Co., Ltd.**, of 88-92, Rochester Row, London, S.W. 1., of the Muskeg tractor. This Canadian-designed machine combines the features of a snow tractor, jeep, and dukw, and can climb snow-covered mountains, cross swamps, river or bogs, and carry firefighting or other equipment through thick forest and bush. Available with a wide variety of personnel or equipment-carrying bodies, it is rubber tracked and has completely watertight chassis and bodywork. The power unit is a Perkins six-cylinder industrial diesel engine developing 88 b.h.p. at 2,400 r.p.m.

**Renold Chains, Ltd.**, of Wythenshawe, Manchester, gave particular prominence to their heavy roller chains as used in large machinery drives as well as a display of various conveyor chains. Power transmission accessories such as sprag clutches and flexible couplings were also shown with demonstrations on working models.

**Ross Engineers, Ltd.**, of 11, Walpole Road, Surbiton, Surrey, demonstrated their two-roll grizzly in action and had scale working models of both the drop-bar feeder and the chain feeder.

**Ruston-Bucyrus, Ltd.**, of Lincoln, introduced a new machine—the 11-RB transit crane of 9 tons capacity mounted on a specially-designed chassis and powered by a Perkins diesel of 98 h.p. The crane itself is powered by a Ruston air-cooled diesel engine of 40 h.p. Boom lengths range from 25 ft. to 70 ft.

**Wilkinson Rubber Linatex, Ltd.**, of Stanhope Road, Camberley, Surrey, demonstrated on their stand the abrasion-resistant properties of Linatex rubber and had in particular a working arrangement of a sand washing, classification, and dewatering plant. Valves, lined pipework, and batch ball-mill with sectioned drums were included among other items shown.

## NEW BOOKS, PAMPHLETS, ETC.

Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

**Alluvial Prospecting and Mining.** By S. V. GRIFFITH. Second (revised) edition. Cloth, octavo. 245 pages, illustrated. Price 42s. Oxford: Pergamon Press, Ltd.

**International Mineral Processing Congress, 1960:** Proceedings. Cloth, octavo, 1118 pages, illustrated. Price 100s. London: Institution of Mining and Metallurgy.

**A History of Platinum:** From the Earliest Times to the Eighteen-Eighties. By DONALD McDONALD. Cloth, large octavo, 254 pages, illustrated. Price 35s. London: Johnson, Matthey and Co., Ltd.

**Mechanized Cutting and Loading of Coal.** By R. SHEPHERD and A. G. WITNESS. Cloth, octavo, 328 pages, illustrated. Price 50s. London: Odhams Press, Ltd.

**British Columbia:** Minister of Mines Annual Report, 1959. Paper covers, 303 pages, illustrated. Victoria, B.C.: Department of Mines.

**Ontario:** Mining Operations in 1958. Vol. LXVIII, Part 2, 1959. Paper covers, 148 pages. Toronto: Department of Mines.

**Somaliland:** Geological Survey Department Report April, 1959-March, 1960. Paper covers, 26 pages. Price Shs. 2/-. Hargeisa, Somali Republic: Stationery Office.

**Kenya:** Mines and Geological Department Index of Annual Reports, 1951-1955. Paper covers, 70 pages. Price Shs. 5/-. Nairobi: Government Printer.

**The British Solomon Islands:** Geological Record, 1957-1958. Edited by JOHN C. GROVER. Paper boards, 113 pages, illustrated. Price 35s. London: Crown Agents for Oversea Governments and Administrations.

**Metal Statistics, 1950-1959:** Metallgesellschaft A.-G. 47th Annual Issue. Paper boards, 284 pages. Frankfurt am Main: Metallgesellschaft A.-G.

## RECENT PATENTS PUBLISHED

A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

**28,278 of 1957 (850-480).** DEPARTMENT OF MINES OF CANADA. Production of Lithium sulphate.

**39,146 of 1957 (849,372).** NATIONAL SMELTING CO., LTD. Blast furnace smelting of zinciferous materials.

**1,434 of 1958 (851,502).** KLÖCKNER-HÜTTENWERT HASPE A.G. Methods and apparatus for coking fine and superfine ores.

**11,523 of 1958 (849,637).** COMMISSARIAT A L'ENERGIE ATOMIQUE. Methods and devices for separating a granular material from a liquid.

**31,709 of 1958 (851,776).** KNAPSACK-GRIESHEIM A.G. Process and device for purifying metal vapours.

**31,824 of 1958 (852,441).** AMERICAN SMELTING AND REFINING CO. Method of operating a blast furnace.

**42,145 of 1958 (849,616).** NATIONAL RESEARCH CORPORATION. Production of tantalum.

**13,772 of 1959 (852,719).** METALLGESELLSCHAFT A.G. Sintering of ores.

## Selected Index to Current Literature

This section of the *Mining Digest* is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

\* Article in the present issue of the MAGAZINE.

† Article digested in the MAGAZINE.

### Economics

**Production, Africa :** *Copper, Rhodesia.* Nchanga Mine, Northern Rhodesia. M. W. RUSHTON, K. E. MACKAY, *Bull. Instn. Min. Metall.*, Dec., 1960.

**Production, Africa :** *Diamonds, Review.* How Diamonds are Found and Mined in Africa. A. F. DAILY, *Min. World* (San Francisco), Oct., Nov., 1960.

**Production, Germany :** *Sulphides, Harz.* The Rammelsberg Mine. H. EICHMEYER, *Mine, Quarry Engg.*, Oct., Nov., Dec., 1960.

**Production, Russia :** *Iron, Krivoy Rog.* Iron Mining at Krivoy Rog, U.S.S.R. H. R. RICE, *Canad. Min. J.*, Nov., 1960.

**Production, Surinam :** *Bauxite, Handling.* Suralco's Bauxite Handling System. J. G. CAZORT, J. J. DE WITTE, *Min. Engg.*, Nov., 1960.

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**Production, United States :** *Magnesite, Nevada.* Basic Incorporated Increases Magnesite Production at Gabbs. *Min. World* (San Francisco), Nov., 1960.

**Resources, India :** *Nickel, Review.* Nickel Ore Deposits in India. S. C. CHAKRAVARTY, *Indian Minerals*, July-Sept., 1959.

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**Uranium, Industry :** *Review, 1959.* The Uranium Mining Industry in 1959. *Ann. Mines*, Nov., 1960.

### Geology

**Economic, Africa :** *Manganese, Ivory Coast.* The Grand Lahou Manganese Deposit. *Ann. Mines*, Nov., 1960.

† **Economic, Australia :** *Tin, Northern Territory.* Exploration of the Maranboy Tinfield. J. SHEPHERD, *Min. Chem. Engg. Rev.*, Sept. 15, 1960.

**Economic, Canada :** *Copper, B.C.* Porphyries, Breccias, and Copper Mineralization in Highland Valley. J. M. CARR, *Canad. Min. J.*, Nov., 1960.

**Economic, Canada :** *Copper-Zinc, Quebec.* The Mattagami Area of North-Western Quebec. M. LATULIPPE, *Precambrian*, Oct., 1960.

**Economic, Canada :** *Lead-Zinc, B.C.* Geology of the H.B. Mine. G. F. WARNING, *Canad. Min. Metall. Bull.*, Oct., 1960.

**Economic, India :** *Gold, Mysore.* Structural Control and Localization of Gold-Bearing Lodes, Kolar Gold Field. S. NARAYANASWAMI and others, *Econ. Geol.*, Nov., 1960.

**Economic, United States :** *Bentonite, California.* Geology of the Otoy Bentonite Deposit, San Diego County, California. G. B. CLEVELAND, *Calif. Div. Mines Special Report* 64.

**Flow, Fluid :** *Resistance, Channel.* Flow Resistance in Sinuous or Irregular Channels. L. B. LEOPOLD and others, *U.S. Geol. Surv. Prof. Paper* 282-D.

\* **Mineralogy, Economic :** *Research, Beryllium.* Recent Researches on Beryllium Ores. THE MINING MAGAZINE, Dec., 1960.

**Prospecting, Sampling :** *Deposits, Mineral.* Sampling Mineral Deposits. *Calif. Div. Mines Mineral Information Service*, Vol. 13, No. 11, Nov., 1960.

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**Copper, Silicate :** *Process, Segregation.* Arizona Copper Silicates Respond to Segregation. *Engg. Min. J.*, Nov., 1960.

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**Iron, Reduction :** *Process, United States.* Iron Ore to Metal by Partial Reduction and Electric Furnacing. *Min. World* (San Francisco), Nov., 1960.

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**Conveyor, Steep-Belt :** *Design, Sandwich.* The Sandwich Conveyor—A Solution for Steep Belt Transportation. E. H. L. RASPER, P. RASPER, *Engg. Min. J.*, Nov., 1960.

**Explosives, Nitrate :** *Use, Slurries.* Blasting Slurries. H. E. FARNAM, *Canad. Min. Metall. Bull.*, Oct., 1960.

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**\*Calculations, Machine :** *Principles, Review.* Modern Computing Methods. T. L. THOMAS, THE MINING MAGAZINE, Nov., Dec., 1960.

**\*Driving, Tunnel :** *Drilling, Ladder.* Ladder Drilling. Trade Notes, THE MINING MAGAZINE, Dec., 1960; *Canad. Min. J.*, Nov., 1960.

**General, Africa :** *Copper, Rhodesia.* Nchanga Mine, Northern Rhodesia. M. W. RUSHTON, K. E. MACKAY, *Bull. Instn. Min. Metall.*, Dec., 1960.

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**Handling, Ore :** *Chutes, Underground.* Causes of "Hanging" in Ore Chutes. V. AYTAMAN, *Canad. Min. J.*, Nov., 1960.

**Hazards, Blasting :** *Fumes, Nitrous.* The Elimination of Nitrous Fumes from Blasting Gases. S. R. RABSON and others, *J. S. Afr. Inst. Min. Metall.*, Oct., 1960.

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**Safety, Support :** *Pressure, Ground.* The Measurement of Rock Pressures Induced by Mineral Extraction. A. W. MAY, *Canad. Min. Metall. Bull.*, Oct., 1960.

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## COMPANY MEETINGS AND REPORTS SECTION

Chairman's statement: RHODESIAN ANGLO AMERICAN LIMITED

(Incorporated in Northern Rhodesia)

### Economic Effects of Political Uncertainty in Central Africa

**PRINCIPLE OF "INDIVIDUAL MERIT" NOT COLOUR SHOULD BE BASIS FOR POLITICAL RIGHTS IN MULTI-RACIAL STATES**

#### **Mr. H. F. Oppenheimer Reviews Progress of Rhodesian Anglo American's Mining and Industrial Interests**

*The following is from the statement by the chairman, Mr. H. F. Oppenheimer, which has been circulated to members.*

THE operations of the copper mining companies from which we derive most of our revenue were not directly affected by the political disturbances and uncertainty that prevailed for much of the year in Central Africa. The three copper mining companies of the Anglo American Group all had successful years. Rhokana Corporation's production was 103,981 tons and its profit after tax, including investment income, was £11.5 million. Nchanga Consolidated Copper Mines had an output of 178,000 tons with profit after tax of £13.6 million. Bancroft Mines, in its first full year of operations since the mine reopened, produced 51,000 tons, with a profit of £3.6 million and was able to declare a maiden dividend of 1s. per share.

Our profit for the year was £7,134,000. This was only £240,000 less than the record profit earned in the year ended June 30, 1956, when the average price of copper was £371 a ton compared with an average price during the past year of £248 a ton. In 1956, however, Rhokana was faced with a heavy capital programme and Nchanga, while nearing the end of its four-stage extensions, had embarked on the open-pit project which also involved large capital expenditure. The beneficial results of this capital work were evident last year in increased production and efficiency at both mines.

#### **Effects of Political Unrest**

Although the operations of the mines were not affected by the political uncertainty, this brought about a sharp decline in the market price both of our own shares and of our investments. When the offer was made of 6% loan stock carrying options to March 31, 1963, to subscribe for shares at 80s. per share for cash or by tendering loan stock, it was hoped that the majority of the options would be exercised for cash and that much of our requirements

of capital to follow up our investments for some years would be provided in this way. So far £588,581 has been subscribed in cash, but the fall in the price of our shares has temporarily stopped the exercise of options and in the present circumstances we clearly cannot rely on the early exercise of the balance of the options to provide the further capital we require. I am therefore pleased that we have been able to transfer an amount of £1,750,000 to the general reserve, which now stands at £6,250,000 and at the same time to recommend a final dividend of 6s. net which, together with the interim of 2s., gives a total distribution for the year of 8s. net.

During the year as a result of underwriting and taking up our rights we acquired £247,705 of the 6½% registered notes issued by The Rhodesia Broken Hill Development Company Limited to provide part of the funds required for an improved plant for the extraction of lead and zinc from the complex ores at that mine. These notes carry the right to subscribe for ordinary shares at 10s. each up to the time when output is expected to be materially increased.

A vigorous campaign of prospecting in the Federation has been continued by Chartered Exploration and the other exploration companies in which we are interested. The possibility of opening up the King Edward Mine near Lusaka, which belongs to Nchanga Consolidated Copper Mines Limited, as a source of pyrites required in the smelter at Nkana, is being investigated.

In January the Kariba hydro-electric project started to supply power to Northern Rhodesia and, shortly after the official opening, power was also made available to Southern Rhodesia. The availability of power at a reasonable cost, which it is hoped will be reduced when the full potential of Kariba is exploited, has already influenced the expansion of our mining interests in Northern Rhodesia, and will undoubtedly assist in promoting further industrial activity in the Federation.

In anticipation of the price of power being reduced in a few years' time, Rhodesian Alloys is planning to enlarge its plant at Gwelo which produces high quality low carbon ferro-chrome for stainless steel manufacture.

A short distance from Gwelo, at Que Que, the new plant at the Rhodesian Iron and Steel Company's works is now coming into operation and Risco will soon be able to supply the local demand for an increased quantity and variety of steel products.

## Constitutional Problems in Africa

You will see that there has been a considerable expansion in that part of the economy with which we are particularly concerned. Calls for material advancement and personal fulfilment are inevitable products of the emergence of the African people, and they must be expected to grow stronger as ambitions and potentialities increase through improved education. This is true of all Africa: but in multi-racial states like the Federation the urgency of helping to meet these aspirations through steady but rapid economic growth is specially pressing.

It must be realized, however, that political uncertainty reduces the rate of economic expansion. This has happened in certain sectors of the Federal economy during the past year and has contributed to unemployment in some towns and a restriction in the opportunities for advancement.

It would be foolish to expect the convulsions which have seized much of Africa to be free from painful and sometimes alarming effects. Quite apart from the disaster of the Congo, the way some of the new African states have developed has been disappointing to many liberal minded people. However, in such states, in the absence of an educated and reasonably sophisticated electorate, some sort of authoritarian government is very likely to emerge. The alternative was not true parliamentary democracy but the enlightened despotism of the Colonial Office, and it does not seem altogether unreasonable that Africans should prefer their own dictators. But, while that is reasonable when you are dealing with purely African countries with only a few thousand European administrators and traders, it is quite another matter when you are concerned with a comparatively large, highly developed European minority which has thrown deep roots in the country. Such a minority will never freely accept, and cannot reasonably be expected to accept, unqualified rule by the African majority in its present state of development. The fact that the Europeans are in a minority does not of itself prove that their point of view is wrong or that their power is negligible.

A peaceful solution to the problem of the multi-racial countries must therefore be sought along other lines from those followed in the purely African territories to the north. It is a great misfortune that the slogan "One man, one vote" should have taken such a hold on liberal opinion. Far from being a guarantee of democracy, experience suggests strongly that in present conditions in Africa it is a guarantee that there will not be a democracy.

## The Monckton Report

The Federation is now awaiting the Review Conference at which its future constitution will be decided. The Monckton Report has confirmed, first, that the economic advantages of Federation are substantial for all three territories and, secondly, that, for good or bad reasons African feeling in Nyasaland and Northern Rhodesia is such that Federation cannot continue without substantial changes to meet African grievances and sentiments. In recommending far-reaching steps to eliminate discrimination on racial grounds in the law and life of the Federation, the report is certainly on firm ground. Nevertheless, there has been great progress in this direction during the year.

It is in the Report's recommendations for new constitutional machinery that it seems to me most open to question. In particular, the proposed composition of the Federal Parliament strikes me as entirely impracticable. In a multi-racial state the principal object should surely be to devise constitutional machinery calculated to encourage politicians to think and act on non-racial lines. The majority of the Commission have, however, abandoned the principle of "individual merit" enunciated in his speech at Cape Town by Mr. Macmillan, echoing Cecil Rhodes' "equal rights for all civilized men." Instead they have recommended an Assembly in which there would be equal numbers of black and white representatives. I am convinced that such a composition would make racial conflict inevitable and government virtually impossible.

I believe that the real hope in a multi-racial country such as the Federation is to stick as firmly as possible to the principle of individual merit, which to my mind implies that anyone irrespective of race who has certain reasonable educational or property qualifications must be entitled to vote on a common roll. We must accept that this means white political majority now and a black political majority in the future. Such a system could only be acceptable if there were effective guarantees against discrimination on racial grounds, either in theory or in fact, by the whites now or by the blacks in the future.

Many people believe that whatever the theoretical merits of this line of thought may be, it is of no practical use because it comes up against the "irresistible force" of African nationalism. Whether African nationalism is really irresistible in a multi-racial country has, however, yet to be decided. It is quite wrong to think that the majority group in a mixed state is necessarily the most powerful.

In Nyasaland, certainly, the African interests must be paramount. In Southern Rhodesia, however, the white population even though it constitutes only about 10% of the total is by no means a helpless community whose views can safely be disregarded. In Northern Rhodesia the white population is, of course, very much smaller, but it is concentrated along the line of rail and in the Copperbelt and here the proportion is quite high enough to make it unwise to regard its views as negligible.

Short of the use of force by the United Kingdom, and I hardly imagine that is contemplated, solutions must be worked out that can be accepted by both black and white and it is very dangerous, therefore,

to set out with the preconception that merely because Africans are in the majority, they are irresistible. Moreover, the events in the Congo have shown that an uncritical acceptance of the demands of African leaders, even if they have wide popular support, can amount to a gross betrayal of the interests of the African masses for whose welfare in Northern Rhodesia and Nyasaland the British Government is in the last resort responsible.

In the Federation a great evolutionary process has been started which offers real opportunities to all its citizens. To break it up would immeasurably retard the economic advancement of the Territories and their peoples.

The future of our company is necessarily bound up with the political future of the country in which

we operate. I can assure stockholders that our faith in the Federation has not wavered. We believe that the companies with which we are concerned have made an important contribution towards the economic advancement, education and personal fulfilment of tens of thousands of Federal citizens, African and European, and it is my sincere hope that we shall be able to enlarge this contribution in the future.

*Copies of the report and accounts and of the complete statement can be obtained from 40, Holborn Viaduct, E.C.1.*

## KAMUNTING TIN DREDGING LIMITED

### Mr. Addinsell's Statement

The 47th annual general meeting of Kamunting Tin Dredging Limited was held on November 29, at 55-61, Moorgate, London, E.C. 2, Mr. J. Addinsell (the Chairman), presiding.

The following is the Chairman's statement for the year ended March 31, 1960, which had been circulated with the report and accounts and was taken as read:

Tin export control continued to operate throughout the financial year but export releases were higher than during the previous year. Our combined tin production in Malaya and Thailand was 1,378 tons of tin concentrate as against 1,252 tons for the previous year, while total permissible exports were 1,395 tons compared to 1,007 tons. The average price realized for our permitted exports was £772 per ton of metal against £736 last year.

The profit for the year of £275,345 was just over £100,000 higher than last year's figure of £174,373. After providing £107,000 for taxation and transferring £23,595 to Contingencies Reserve, there remains a sum of £144,750 for disposal. Your Directors recommend the payment of a final dividend of 25%, which, with the interim dividend of 10%, paid on March 4, will absorb £143,363, leaving £1,387 to be added to the carry forward.

Our total contributions to the Buffer Stock, which ceased in Malaya in August, 1959, and in Thailand in March, 1960, amounted to £167,997 which is shown as a separate item in the Balance Sheet.

The Technical Managers' Report, which appears on page 7 of the Report and Accounts, summarizes the operations during the year under review and it will be seen that due to export control we relied, in the main, on the outputs from the No. 6 dredge in Malaya and the No. 1 dredge in Thailand. Both the No. 5 dredge in Malaya and the No. 2 dredge in Thailand re-started on February 1, 1960, due to the improvement in the export quota position.

#### Transfer of Dredges

No. 6 dredge, as shareholders will know, is approaching the end of its reserves at the Tekka-Taiping area and it is expected that dismantling for transfer to the area acquired from the Taiping Rubber Company will start during the second half of 1961. The life of this property is estimated at 16 years. No. 5 dredge may have sufficient reserves

as its present site to operate until about April, 1962, but this will depend upon whether it proves payable to mine certain marginal ground. Thereafter, it is now proposed in due course to transfer this dredge to the Company's Eastern Tailings area, which, as a result of undertaking a programme of reborning, Anglo-Oriental (Malaya) Limited are able to recommend as reasonably profitable ground for this unit to dredge. This should give it a further ten years of life. As regards our No. 4 dredge in Malaya, in view of its age and small capacity there seems little hope of finding a suitable new area which would provide it with a further lease of life but the possibility of working a small area of adjacent low grade ground and also re-treating old dredge tailings is being investigated.

The two dredges in Thailand continue to work satisfactorily and the life of the property with two dredges working is estimated at about eleven years.

Shareholders will appreciate that until the projected programme of dredge removals is completed—and a period of some eighteen months is normally necessary for complete dismantling and re-erection of a dredge—our Malayan production will be materially curtailed and a temporary falling off in our profits must be expected. I may say, however, that our production and sales for the current year should be substantially higher than for the period under review. The cost of removal of the two dredges is estimated at approximately £700,000 and with a further addition to our Revenue Reserves next year we should have sufficient resources to carry out this programme.

The announcement that the State of Emergency ended in Malaya on July 31, 1960, was most encouraging and more active prospecting for new mining areas should result.

Export control has been removed for the quarter October 1, 1960, to December 31, 1960, and shareholders have been informed of this by circular letter. I trust that the improvement in the statistical position of tin which permitted such a satisfactory decision will be maintained.

I will conclude by again thanking Anglo-Oriental (Malaya) Limited, our Managers in the East, for the continued excellent service they have rendered to your Company.

The report and accounts were unanimously adopted.

## WANKIE COLLIERY COMPANY LIMITED

(Incorporated in Southern Rhodesia)

### EFFECTS OF KARIBA POWER ON SALES

#### Increased Investment Income

The following is from the statement by the chairman, Mr. K. C. Acutt, C.B.E. which has been circulated with the annual report and accounts:—

Coal sales of 3,849,618 tons reflect an increase of 231,001 tons over sales last year, but as a result of power becoming available from the Kariba hydro-electric project, the demand for coal for thermal generation was falling at the end of our financial year. As further power becomes available from Kariba there will be a further decline in the demand for coal for power-generating purposes, but there has been a welcome, although at present small, increase in the consumption of coal in other fields. I am hopeful therefore that as a result of the industrial development which is taking place or is planned in the Federation, sales, although likely to be lower for a few years, will remain at reasonably satisfactory figures.

As the chairman indicated last year, we hope that with the assistance of our rising investment income and by drawing, if necessary, on unappropriated profits, we will be able to maintain dividends at their present level during the period that coal sales may suffer a decline.

#### Sales

Our coke sales for the year showed a small decrease of 16,417 tons compared with last year, but this was largely caused by the commissioning of the new coke ovens at the Rhodesian Iron and Steel Company Limited, works which draws its coal from us. There, however, appear to be good prospects for a higher level of coke sales next year.

Our sale of coal, coke, and tar to the former territory of the Belgian Congo was adversely affected by the unrest which followed the granting of independence in July. Deliveries of these products to the Union Minière copper mines and the Katanga Railways were resumed very quickly, but supplies to general consumers in the territory were suspended for several weeks.

The highly competitive conditions in the coal export market continued during the year and in spite of our efforts to obtain an outlet for some of our surplus production capacity we have been unsuccessful. We and our export agents are, however, continuing our efforts.

Satisfactory improvement was achieved in our brick sales but sales of the various items from our by-products plant were generally lower than 1959.

The profit for the year, before charging taxation, was £1,639,060, which is £267,016 higher than last year. Most of this increase in profit is attributable to additional sales but revenue from investments also increased and was £67,649 higher than last year.

#### Investments

Most of the company's funds are invested in short-term loans of £2,350,000 to Anglo American

Rhodesian Development Corporation, Limited, which has purchased railway trucks for hire to the Rhodesia Railways, and a direct loan of £500,000 to the Rhodesia Railways. In addition, we hold £675,260 of medium and long term Federal Government Stocks.

During the year we invested the sum of £266,624 in shares of Rhokana Corporation, Limited, and Nchanga Consolidated Copper Mines, Limited. This, together with our interest in our subsidiary company, Sandringham Investments, Limited, and an increased holding in Clay Products, Limited, arising from a further issue of capital by that company, brought our total holdings in Rhodesian equities to £390,577.

We have purchased £469,500 of our own debentures on the market at satisfactory prices. The difference between the purchase price and the nominal value of the debenture stock, an amount of £59,479, has been placed to reserve.

#### Coal Price

The notified average selling price of coal within the Federation, which was fixed at 20s. per ton with effect from November 1, 1959, is to remain unchanged until October 31, 1961, subject however to the right to apply to the Government for a revision of the price in the event of any unforeseen conditions arising before that date.

The deficiency revenue of £91,024 calculated in terms of the price agreement and brought forward at the end of last year, has been reduced to £33,595. This amount is recoverable in future years.

During the year it became clear that the production capacity of Nos. 2 and 3 Collieries was adequate to meet the estimated demands in the next few years and in March this year it was decided to close down No. 1 Colliery which had been placed on a care-and-maintenance basis some two years ago. The old underground workings of this colliery are expensive to maintain and the consulting engineers recommended that these old workings should be abandoned and sealed off.

No loss of coal reserves will result from this decision, as if at some future date it should be desirable to restart production in the No. 1 Colliery area, a new shaft would make available the coal which remains to the north of the old workings and no difficulties would be experienced in transporting this coal to the existing surface plant. Nos. 2 and 3 Collieries have continued to operate satisfactorily during the year.

In May of this year the first annual Central African Trade Fair was opened in Bulawayo by Her Majesty Queen Elizabeth the Queen Mother. The company exhibited a display of its products which attracted considerable interest from visitors attending the Trade Fair from the whole of Southern Africa.

## RHODESIAN SELECTION TRUST GROUP OF COMPANIES

*Companies in the Group are incorporated in either Northern Rhodesia, Southern Rhodesia or Bechuanaland.*

The following is an abridgment of the Statement dated 22nd October, 1960, by the Chairman, Sir Ronald L. Prain, O.B.E., which has been circulated to members.

Production of copper from the group's three mines during the year which ended on June 30 last was the highest yet recorded. The output of copper was 217,548 tons, of which 216,576 tons were sold for an aggregate sales value of £53,328,539. These operations yielded a total profit of approximately £20,000,000 before making reserves or allowing for taxation.

The group's production represents about 7% of the free world's output of primary copper. The following table shows how this production was made up:—

	long tons
Mufulira . . . . .	103,153
Roan Antelope . . . . .	92,341
Chibuluma . . . . .	22,054
Total . . . . .	217,548

## ORE RESERVES

The published ore reserves of the group at June 30, 1960, are as shown below:—

	short tons	Grade total copper	% cobalt
Mufulira . . . . .	178,769,000	3.35	—
Roan Antelope . . . . .	94,592,000	3.04	—
Chibuluma . . . . .	9,790,000	4.89	0.18
Baluba . . . . .	112,000,000	2.41	0.16
(undeveloped)			
Chambishi . . . . .	35,000,000	3.37	—
(undeveloped)			
Total . . . . .	430,151,000		

## THE COPPER MARKET

The copper market was steady and even strong at times throughout the financial year under review. Various influences contributed to this, including a prolonged strike in the United States mines which occurred during the latter part of 1959 and early in 1960, and anxiety over political events in Africa. In addition, the market was influenced from time to time by fears about stoppages of work elsewhere, and by certain technical features which operated to maintain the price.

Generally speaking, consumer demand in Europe was particularly strong while in America the reverse was the case.

However, since the resumption of work at the United States mines there has been a steadily growing disequilibrium between production and consumption of primary copper in the free world. This has been less due to falling off in consumption

than to steadily increasing production, including the bringing in of certain new mines. Since April this year this position has become more apparent, and producer stocks have risen to the highest level since August, 1958. During the past four months copper prices have tended to reflect this position of over-supply and, in recognition of this underlying situation, certain mines, including the mines in this group, recently announced cuts in production which, in our case, are at the rate of 10% per annum. Shareholders who have read my reports in recent years will know that I regard this as the most realistic method of correcting a position of over-supply.

It follows therefore that until further notice our operations will be on a curtailed basis. Such a situation is to be expected from time to time, and does not signify any basic change in the long-term outlook for copper. Our development plans continue unchanged.

## Copper Prices and Supplies

The average price we received for all our copper during the year was £246 per long ton. During the financial year the price of copper on the London Metal Exchange fluctuated between £279 10s. per ton and £209 10s. per ton. While a tribute should be paid to the behaviour of the London Metal Exchange prices, in the sense that there were no violent daily fluctuations, it remains nevertheless the opinion of many that a variation of this sort in a 12-months period is one which is harmful and unsettling to the industry. Producers are by no means complacent about this state of affairs and are constantly considering how a greater degree of stability can be introduced into the copper market. To this end the philosophy of cutting production and/or sales in the event of over-supply seems to be increasingly accepted in the industry. Other points which continue to receive the attention of producers include the question of a more enlightened policy of stock retention in the various markets of the world, combined with the possibility of selling at fixed prices which would not necessarily mean the elimination of the London Metal Exchange as a useful pricing medium in the market.

If producers are more aware of the importance of these policies on the course of prices for their main product, it is also true that fabricators now appear to have a much greater understanding of some of the problems of raw material producers and, in particular, of the problems which can arise in certain parts of the world which are closely linked with Europe, in the event of unduly great swings in prices.

## ROAN ANTELOPE COPPER MINES LIMITED

## Production and Costs

Production of ore was 6,660,000 tons which compares with the figure of 5,550,000 tons for the previous year. The grade of ore milled was 1.85% compared with 1.97% in the previous year.

Costs rose from £154 per long ton of copper produced in the previous year to £159 per ton in the year under review. This was mainly due to an increase in the cost of bonus scheme payments to employees, which are based on profits of the Copperbelt as a whole.

In addition, a greater proportion of the mine's output was refined as electrolytic copper and a smaller proportion produced as fire refining grade copper. The production in terms of all grades of copper was 92,341 long tons, a record for this mine. Production for the current year will be less than last year on account of the production cut.

#### Financial Results

Sales for the year amounted to 91,051 long tons which were sold at an average price of £245 per ton, an increase of £25 per ton compared with the previous year. The profit margin per ton increased to £81 compared with £68 during the previous year.

On this basis the gross profits amounted to £7,331,000. To this has to be added the increase in the value of copper stocks amounting to £86,000. Interest earned, less interest paid, and miscellaneous minor items brought this profit to £8,052,000, which represents a 35% increase on the corresponding figure for the previous year. In these profit figures there is included a provision for a dividend receivable from Ndola Copper Refineries, Limited.

After taking into account appropriations and sundry adjustments, including transfer to loan stock redemption reserve, the balance available for dividends was sufficient to justify the recommendation of a final dividend of 10½d. gross per share, less taxes, which, together with the interim paid last July of 4½d. gross per share, less taxes, makes a total for the year of 1s. 3d. gross per share, an increase of 50% on the previous year.

#### NDOLA COPPER REFINERIES LIMITED

A total of 61,231 long tons of copper was produced for customers, of which 95% was for account of Roan Antelope Copper Mines Limited. It is expected that during the current year the refinery will treat all the output from Roan Antelope and that the total through-put may exceed 80,000 tons.

These operations resulted in a gross profit of £441,000 compared with £240,000 in the previous year. Miscellaneous adjustments of income from interest raised this profit to £448,000.

Allowable deductions for tax purposes exceed the trading profit so that there is no tax liability in respect of the year.

#### MUFULIRA COPPER MINES LIMITED

##### Production and Costs

Production of ore for the year amounted to 4,900,000 tons compared with 4,100,000 tons for the previous year. The average grade of ore sent to the mill was the same as that of the previous year, namely 2.65% total copper. This resulted in a record production of 103,153 long tons of copper for the year, of which the greater proportion was electrolytic. During the current year it is expected that production of electrolytic copper will decrease

and the production of fire refining grade copper will increase. The overall production of the mine is expected to be less than that of last year on account of the production cut to which I have already referred.

As far as costs of production are concerned the average cost increased from £149 per ton in the previous year to £160 per ton. The main increases were in respect of mining, which has been charged with relatively large sums for development in connection with Mufulira West, and the bonus scheme for employees which, being based on profits, has increased as a result of the generally larger profits of the Copperbelt during the year.

#### Financial Results

Sales for the year amounted to 103,040 long tons, which were sold at an average price of £249 per ton, an increase of about £21 per ton compared with the previous year.

The profit margin per ton of copper increased from £80 in the previous year to £89 and on this basis the gross profits amounted to £9,144,000. To this has to be added the increase in the value of copper stocks amounting to £386,000. Although our opening and closing stocks were approximately in balance the increase in the stock value is due to the increase in the cost of production.

Interest earned, less interest paid, and acceptance credit expenses brought the total profit to £9,954,000 compared with £7,574,000 in the previous year.

Tax liability on this company's profits is estimated to be £3,300,000.

An interim dividend of 2s. 7½d. gross per share, less taxes, was paid in July. The board now recommends a final dividend of 5s. 3d. per share, which, if accepted at the annual general meeting, will make a total dividend for the year of 7s. 10½d. gross per share, less taxes, compared with the total dividend last year of 5s. 6d. gross per share.

#### CHIBULUMA MINES LIMITED

##### Production and Costs

The production of ore was the highest yet attained by the company, amounting to 575,000 tons, running 4.65% copper. This resulted in a production of 22,054 long tons of copper metal, mostly in the form of fire refining grade.

The average costs for the year amounted to £149 per ton, an increase of about £5 on the previous year. A reduction in mining costs and overhead charges was off-set by higher milling costs, due partly to adjustments relating to the apportionment of costs between copper and cobalt. Royalty payments and employees' cash bonus were higher and there were miscellaneous changes under other headings, as shown in the manager's summary of operations for the year.

The cobalt refinery at Ndola experienced certain operating difficulties, in spite of which the cobalt matte production for the year at 9,778 short tons showed an increase on that of the previous year. The costs of production, including the cost of moving the matte overseas for refining and all overseas refining and other costs and mineral

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royalties, averaged 11s. 11d. per lb., of cobalt delivered U.S.A. after crediting revenue from the sale of 850 long tons of copper recovered as a by-product.

### Sales

Copper sales for the year amounted to 22,485 long tons which realized an average price of £239 per ton compared with £217 per ton in the previous year.

Cobalt metal is utilized at present to meet part of the annual obligation we have to the United States Government in respect of interest and loan capital repayments. We thus delivered 800 short tons of cobalt metal at an average price of £1,209 per ton with a total value of £967,000.

### Financial Results

The gross trading profit on copper amounted to £2,041,000, easily a record profit for this company.

Deducting loan interest and adding interest receivable, the net profit came to £1,972,000, compared with £1,258,000 the previous year, before taking into account cobalt profits. The latter amounted to £12,000 compared with £87,000 in the previous year, due principally to the lower price received during the year.

The total profit for the year was £1,984,000, which does not attract any charge for tax on account of the Federal tax laws applying to new mines.

Under the terms of our agreement with the United States Government we are obligated to pay in each year metal to a value equivalent to 75% of the previous year's net profits, after adding back interest payable.

Our cobalt and copper deliveries amounted to £1,131,000 and this was allocated against accrued interest and redemption of loan capital. The loan from the United States Government at the end of June, 1960, was reduced to £1,953,670. During the current year our repayment obligation will amount to £1,584,000. Part of this will be allocated against interest and the balance against loan principal. We expect that the loan will have been reduced by June 30, 1961, to between £400,000 and £500,000 outstanding, out of the original £5,000,000 advanced by the United States Government.

### RHODESIAN SELECTION TRUST LIMITED

The revenue for the year came almost entirely from dividends payable by Mufulira Copper Mines Limited amounting to £2,498,000. Administration and sundry other expenses, less interest received, reduced this figure to a net profit of £2,398,000, on which there are no taxes payable.

This company has certain commitments in respect of expenditure on prospecting, and on further development work at Baluba and Chambishi orebodies. It is necessary to make provision out of profits for these commitments and, in addition, the company has recently made certain purchases of shares in the Mufulira, Chibuluma, Chambishi, and Baluba companies, which will require financing from profits, though not wholly out of the profits of last year or this year. To meet these commitments the board has reserved £325,000 which will be transferred to the general reserve.

In July an interim dividend of 6d. per share, less taxes, was paid and the board now recommends a final of 1s. gross per share, less taxes, which, if approved in general meeting, will cost £1,414,000. The total for the year will be 1s. 6d. gross per share, compared with 1s. 1d. for the previous year.

### EXPLORATION COMPANIES

Prospecting work in Northern Rhodesia continued at a high rate during the year in the exclusive prospecting areas held by Kadola Mines Limited, Luapula Mines Limited, Mwinilunga Mines Limited, and Chisangwa Mines Limited. A great deal of information about geological structures and mineral occurrences has been accumulated which is now resulting in more concentrated work in selected areas.

Rhodesian Selection Trust Exploration Limited has continued extensive prospecting work in Southern Rhodesia principally in the Lomagundi area. The results in this area continue to be interesting and encouraging.

I reported last year on the agreement signed between Rhodesian Selection Trust Exploration Limited and the Bamangwato Tribal Authority of Bechuanaland whereby a prospecting concession over almost the entire area of 44,000 square miles in the Bamangwato territory was granted to this group. The company which has been formed to carry out the work on this concession is known as Bamangwato Concessions Limited, in which Rhodesian Selection Trust Exploration Limited holds a controlling interest, with Mond Nickel Exploration Limited, a Canadian company, and Minerals Separation Limited, a United Kingdom company as partners. Operations conducted by this company began in January, 1960, and have continued on an increasing scale throughout the year.

### CONCLUSION

The Rhodesian copper industry has not yet achieved its potential production capacity. Its prospects depend on two major considerations, the first being the future of the world copper market and the second the future of the political environment in Africa and, in particular, in Rhodesia. As far as the future of the copper market is concerned, I have expressed my confidence throughout many years, and nothing has occurred to alter my view in that respect. I think it can be taken almost for granted that there is a general realization on both sides of the industry that the future development and orderly growth of this industry depends on the maintenance not only of a correct price but a stable one. Production and marketing policies must be designed towards this sole end.

As far as the future of Rhodesia is concerned it is to be hoped that the negotiations in the coming year will be based on a sense of realism which will ensure a solution leading to stable political conditions. If this can be achieved, investment on a large scale should once again flow to this country and on that basis the prospects for all its inhabitants are considerably more promising than those which face most countries in a similar state of development. Without such stability, a golden opportunity will be either wasted or deferred.

# JOHANNESBURG CONSOLIDATED INVESTMENT CO., LTD.

(Incorporated in the Union of South Africa)

The annual general meeting of Johannesburg Consolidated Investment Company, Limited, was held in Johannesburg on December 6, 1960.

Mr. H. J. Joel presided and, in the course of his speech, said:—

It gives me great pleasure to be with you once again and to present for your consideration and approval the Directors' Report and Accounts for the year ended June 30, 1960.

For the year under review the profit, before tax, of your company and its wholly-owned subsidiary, Barnato Brothers, Limited, amounted to £2,568,160, an increase of £527,244 over the comparable figure for the previous year. This satisfactory result arose mainly from an improvement in our dividend income, the greater part of which was accounted for by our diamond, copper, and platinum interests.

Depreciation of the book value of investments resulted in a drop of approximately £350,000 in the charge for taxation. The reason for the variation in the incidence of taxation for the year ended June, 1960, and for the previous year, has already been fully dealt with in the Directors' Report.

The net profit after tax was £2,099,653. The transfer to Investment Reserve amounted to £603,903 and, in addition, the General Reserve was increased by £600,000. The dividend was increased from 4s. 6d. to 5s. per share, while the carry forward of £240,639 remained virtually unchanged.

## Investments

During the financial year there was a general decline in the market value of shares in companies operating in Southern Africa.

The book value of most of our investments is well below market value and was, therefore, not affected by this decline. Of the decrease of £604,000 in the total book value, about one-half was accounted for by a further depreciation of our investment in Freddie's Consolidated Mines, Limited, which would probably have occurred irrespective of the general fall in the market value of South African shares.

This general fall naturally affected the market value of our quoted securities. After making due allowance for shares purchased or sold during the year, the reduction in the market value of our investments at June 30, 1960, as compared with the market value of the same investments at June 30, 1959, amounted to about £2,400,000 or about 10% of their value on the former date. The effect of this fall upon the total market value of our investments was, however, largely offset by the acquisition of new investments during the year, certain of which, notably Western Areas Gold Mining Company, Limited, had appreciated above cost by June 30, 1960.

The decline in market values which took place over the financial year has as its background an anxiety concerning African affairs which has affected nearly all investments in Southern Africa. It is against this background of anxiety that I propose later to comment on the changes which are now taking place in Africa and the bearing which these changes may have on the affairs of our company.

Leaving aside for the moment the sociological and

political factors that are affecting and will continue to affect affairs in Africa, the immediate outlook for our investments is, generally speaking, sound.

## Metal Markets

The market for diamonds is at present satisfactory and the demand for platinum although quiet remains steady. World production of copper is at the present time in excess of consumption and various producers have instituted cuts in output or sales in an effort to correct this position. In my opinion, the fact that there arises from time to time an excess capacity to produce copper is not one which need cause undue alarm or surprise.

Plans for the establishment of a new mine, or an additional source of production, are designed to meet a future estimated level of demand and are drawn up and put in hand several years before they can be brought to fruition. During the period which elapses before the new source of supply can be brought into production, actual consumption is almost certain to fluctuate in relation to estimated consumption. It is unlikely, therefore, that a number of independent producers, thinking and acting separately, will arrive at an aggregate rate of production which will exactly match demand year by year.

The well-being of an industry, such as the copper mining industry, producing base metals which are used in large quantities, requires that consumers should be assured that the metals which they may need will be freely available to them for projects, the plans for which have necessarily to be formulated many years ahead by the user no less than by the producer. It is well recognized by producers that consumption must not outstrip production for any length of time and, as a result of plans made to avoid this situation, it is almost inevitable that periodically excess productive capacity should emerge. This is of less importance than the fact that the field for the use of copper throughout the world is likely to extend. If this extension is to be met by copper, in competition with aluminium or other possible substitutes, it is essential that the demand can be fully catered for at reasonable prices.

A matter which is of some current interest is the behaviour of the London Gold Market over recent weeks. The price realized for gold sold on that market rose appreciably during October, 1960, and has since remained above the official price. As a result of this increase, the price realized for gold sold by the South African gold mining industry during October was 254s. per oz., and during November, 253s. 10d. per oz., compared with an average of 249s. 9d. per oz. for the twelve months to September, 1960. It is not clear at this stage whether or not this increased price on the London market is merely of a temporary nature, but the fact that significant quantities of gold have during recent weeks been sold at prices in excess of the official dollar price may be some indication of the extent to which opinions have begun to change regarding the dollar price of gold. The gold mining industry is meanwhile obtaining the benefit of a slightly higher price for its output.

### Progress of Gold Mining Interests

We are maintaining our activity and interest in the search for new gold areas and their development. A syndicate known as the Western Areas No. 2 Prospect has been formed under the management of your company. The syndicate, in which we have a 37½% contributing interest, is undertaking a prospecting programme in the neighbourhood of the Western Areas Gold Mining Company lease area. We have also formed syndicates under our management to undertake three major prospecting projects, one to the north of the new goldfield in the Leslie-Kinross area, one near the Klerksdorp goldfields, and one in the Kroonstad area. These projects, in which we have a 44% contributing interest, will take several years to complete.

Progress at Western Areas Gold Mining Company, Limited, in which we have a substantial investment, has been gratifying. Shaft sinking has been carried out at a satisfactory average monthly rate of advance and, in consequence, the Ventilation Shaft has been completed to its final depth of 3,616 ft.; it has been equipped for hoisting during the development period and during October, 1960, development commenced from it. The sinking of the Main Shaft continues. The values obtained in the intersections of the Elsburg Reefs in both shafts were encouraging. Overall progress is well ahead of schedule and there seems little doubt that production will commence before the date anticipated by Western Areas in the prospectus issued by that company.

With regard to Freddie's Consolidated Mines, Limited, this company announced during September, 1960, that in order to conserve funds, development on the Basal Reef horizon had been curtailed. It is anticipated that production will continue throughout the year 1961, and probably somewhat longer. During that year it should be possible to determine whether or not the Elsburg Reefs, which are being exploited by the Loraine mine some 20,000 ft. to the north of Freddie's, are likely to persist into the Freddie's lease area. In the event that the exploration in the Elsburg Reefs fails to disclose any economic tonnages, then, failing an increase in the price of gold, all development work at Freddie's will be stopped and such ore reserves as remain and are capable of profitable extraction will be mined before the final closure of the mine.

### Review of African Affairs

It is appropriate that I should now make some comment on the changes which are taking place in Africa and the bearing which these changes may have on the affairs of our company.

The decline in the market value of the shares in most companies operating in Africa, to which I referred earlier, has as its background an anxiety concerning African affairs. This lack of confidence on the part of investors may stem in varying degrees from concern about the safety of the capital employed, doubts as to the ability of enterprises on the African continent to maintain their earnings, or misgivings in regard to the fiscal policy of local governments.

By far the greater proportion of our investment is in companies which either operate in Africa or

are directly dependent upon operation in this continent. As approximately two-thirds of our investment income is at the present time drawn from our interests in diamonds, copper, and platinum, I shall confine myself mainly to the question of whether or not these particular industries can reasonably be expected to maintain their present operations and their present level of dividends. An answer to this question must depend in the first instance upon whether or not they are likely in fact to continue in production during the social, political, and industrial changes which are taking place in many parts of Africa.

### Important Factors to be Considered

I am of the opinion that it is unrealistic to envisage in these various African territories situations in which industry will be paralyzed for long periods of time by the withdrawal of labour. On the other hand, it would also be unrealistic to envisage the preservation of the *status quo* of the African labour force or to believe that conditions will always improve sufficiently quickly to avoid labour difficulties. Such has not been the experience elsewhere and I do not think it will be our experience in Southern Africa.

Assuming that production is likely to continue without undue interruption, the next important factor to be considered, in so far as it affects the future profitability of industries in Africa, is the question of African labour costs. As I have suggested, there is no reason to suppose that the cost of such labour will remain static. On the contrary, it is to be expected that the wages and benefits received by Africans will increase. An increase in the cost of labour has in the older industrialized countries of the world normally been accompanied, in varying degrees of rapidity, by improvements in both the utilization and the productivity of the labour employed. The hard facts of economic life which have brought about such improvements elsewhere are likely to operate in the case of Africa as well. In particular, in Africa, as labour becomes more expensive, so is its utilization likely to become more effective.

Apart from the development of the more effective use of the available skills latent in the labour force, it is likely that there will also be improvements in productivity as a result of further mechanization and the installation of labour-saving techniques.

My remarks indicate, I think, a measure of confidence, firstly, that industry will be able to continue in production on the African Continent, notwithstanding the impact of rapidly changing circumstances, and, secondly, that the profitability of industry need not necessarily be seriously affected by rising labour costs.

While your directors are naturally fully aware of the potential dangers inherent in investment in Africa at the present time, we are of the opinion that the substantial rewards obtainable from such current investment outweigh the potential risks as we now see them.

Given no major disturbances in the immediate future, it is likely that our dividend income for the current year will be somewhat greater than that for the year ended June 30, 1960.

## RHOKANA CORPORATION LIMITED

(Incorporated in Northern Rhodesia)

### MINING OPERATIONS NOT AFFECTED BY POLITICAL DISTURBANCES

#### Mr. H. F. Oppenheimer Reviews Developments in Copper Market

The following is from the review by Mr. H. F. Oppenheimer, the chairman, which has been circulated with the annual report and accounts:—

The year was free of strikes and industrial disputes and, as the political disturbances in the Federation did not affect mining operations, production throughout the Copperbelt continued uninterrupted. Profits from our own mining operations and income from dividends received on our investments in other copper mining companies were higher than in any year other than 1956 when the copper price averaged some £120 per ton more.

The net profit after taxation last year was £11,534,000 and, after making provision of £2,000,000 for capital expenditure and transferring £750,000 to general reserve, the board was able to recommend a final dividend of 5s. 6d. (net) per £1 unit of stock, which, together with the interim dividend of 1s. 6d. makes a total dividend distribution of 7s. (net) per unit for the year ended June 30, 1960.

Bancroft Mines, Limited, in which we have a large interest, made a satisfactory profit of £3,693,000, and has recommended a maiden dividend of 1s. (net) per share.

#### Copper Market

During the year the world copper market was very much influenced by strikes of long duration at the plants of most of the major United States producers which resulted in a loss in production of over 300,000 short tons of copper. In July, 1959, the copper price on the London Metal Exchange had receded to £215 per ton but, as a result of the exhaustion of stocks held in America, the price advanced steadily, reaching £266 in November. From then on, with a few notable fluctuations, the price was maintained between £250 and £270 until mid-April, 1960, when anticipation of strikes in Chile gave impetus to the market and the price rose to £279, the highest point reached since December, 1956. Thereafter, when it became apparent that the strikes which had broken out at El Salvador and Potrerillos mines at the beginning of May, 1960, were unlikely to be of long duration or to spread to the other copper mines in Chile, the price weakened again, falling to levels around £250 in June, 1960.

During July and August the statistical picture showed that unless there were some reduction in supplies to the market either through strikes or voluntary cuts there would be an oversupply of copper in the last quarter of the year. This position of oversupply is chiefly due to the failure of the United States economy to recover to the extent expected after last year's steel strike and to increased world production. As a result, the price of copper fell steadily during July and August, reaching £234½ on September 1. During September the price was held reasonably steady by the expectation of a strike at Chuquicamata.

The producers can, I believe, make a valuable contribution to the stability of the copper price. We have indicated our willingness to act in concert with other major producers in times of oversupply to reduce output or withhold copper from the market. When the price reached £225½ on October 3, the Anglo American Corporation Group of copper companies, in conjunction with the Rhodesian Selection Trust Group, announced a 10% cut. Our opinion is that at such times the right step is first to cut sales, not production. This enables producers to establish reasonable stocks from which they can supply the market in times of shortage, and so help to prevent the price running away.

Although the year was free of industrial disputes, the Mining Joint Industrial Council, which consists of representatives of the Copperbelt's six producing mines and six representatives of the Northern Rhodesia Mine Workers' Union, met frequently over a period of nearly a year to evolve a scheme for the further advancement of African employees into the field represented by the European Union. I am glad to say that these negotiations were most successful and produced a solution embodying a unified wage scale in the industry and the promotion of employees on the basis of merit irrespective of colour.

#### Learner Training Scheme

An important feature of the scheme is that a broad outline of a learner training scheme for all our employees has been agreed upon and satisfactory wage rates for surface and underground learners have been established. The industry will thus no longer be inhibited from offering mining careers to young men at the end of their schooling. The problem of unemployment amongst European and African youth in Northern Rhodesia is serious and the new training scheme should provide an outlet for these young people, many of whom are sons of our employees.

The inadequacy of facilities for the schooling of Africans, even at the primary level, has caused us anxiety for many years. This year the copper mining companies administered by the Anglo American Group and the Rhodesian Selection Trust Group joined in providing £1,300,000 to enable the Northern Rhodesia Government to expand its facilities so that all African children will, over the next few years, be admitted to a course of at least six years' primary education. Further provision has been made for secondary education and for the training of African teachers. No time has been lost in making additional classrooms available, and over 1,600 places were provided at the beginning of the new school year in August, 1960, for children who would otherwise have missed schooling, or had to wait a year or more for vacancies.

The provision of technical education is of special importance to the industry and to the territory as a whole. The companies which established the Copperbelt Technical Foundation will shortly receive a report on the further requirements for technical education in relation to the needs of industry. This report, which is being produced by a team of leading educationalists under the chairmanship of Sir David Lindsay Keir, should prove of great value to the Governments and the mining industry.

This review had to go to press before there was time for full consideration of the Monckton Commission's Report. I am, however, proposing to make some comments on the report and the political situation in Central Africa in my statement to

stockholders in Rhodesian Anglo American Limited, the printing of which is being delayed for this purpose. As the outlook for our Company inevitably depends to a considerable degree upon political developments in the Federation, I feel stockholders might like to see this statement.

**The statement to stockholders in Rhodesian Anglo American Limited referred to above has been circulated also to stockholders in Rhokana Corporation Limited, and an abridgement of the statement is published on page 36.**

*Copies of the report and accounts and of the full statements by the chairman of this company, and of Rhodesian Anglo American Limited, can be obtained from 40, Holborn Viaduct, E.C.1.*

## THE RENONG TIN DREDGING COMPANY, LIMITED

### Substantially Improved Results

#### Sir John Hay's Statement

The forty-seventh annual general meeting of The Renong Tin Dredging Company, Limited, will be held on December 13 at 52-54, Gracechurch Street, London, E.C.

The following is an extract from the circulated statement of the chairman, Sir John Hay:—

During the last financial year tin exports continued to be restricted under the terms of the International Tin Agreement, but in contrast with the preceding year the permitted rate was progressively increased. In 1958-59 total world exports were held down to 86,000 tons, but in the period under review the limit was raised to 128,500 tons. Even with the increasing flow of metal, the average monthly price which was £792.3 per ton in July, 1959, varied only marginally throughout the year and in June, 1960, was £793.2 per ton. With effect from October 1, 1960, all restrictions on the export of tin have been lifted entirely and producers may once again despatch to smelters the whole of their output of ore.

The manager of the Tin Buffer Stock still has more than 10,000 tons tin metal in reserve as well as substantial funds which he can employ to stabilize prices should freedom from export restriction prove too heady a wine for the industry after an abstinence of nearly three years, although since May this year, his authority to buy and sell tin does not operate except when the price is below £780 or above £830 per ton.

#### Accounts

Total sales during the year amounted to 884 tons of ore as compared with 654 tons in 1958-59. In consequence and because of the higher average

price received the profit before tax was nearly trebled, at £76,722. The Board recommend an increase in the Ordinary Dividend for the year to 9d. per 2s. unit of Stock, free of tax.

#### Mining Operations

At Jinjang tin-ore production exceeded that for the previous year by a small margin, although the average recovery was reduced from 11.26 oz. per cubic yard to 8.47 oz. The poor recoveries have been aggravated by loss of digging depth due to uneven formation of the bedrock. It is hoped that the unit will move into higher-grade ground within the next few months.

No. 3 Dredge, which was benched in May, 1958, because of tin restriction, was put to work again at the end of November, 1959. The tailings section at Rasa, where this unit has operated so successfully, has little remaining ground containing payable values, but it is hoped that sufficient remains to keep this dredge operating throughout the current financial year, after which it must close down for good.

No. 2 Dredge has continued working well throughout the year at Kuala Kubu Lama, but in a sector where the ground values are lower than the average for the whole selected area.

The company has been fortunate in acquiring at a favourable price a dredge that is suitable for transfer to Kuala Kubu Lama. It is a wood-burning steam dredge, as are both dredges at Rasa, but it has a greater capacity than either and is in far better condition structurally than No. 3 which it replaces. Such a unit should be capable of working profitably at Kuala Kubu Lama where the ground values are only moderate.

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## LAKE VIEW AND STAR

The fiftieth annual general meeting of Lake View and Star, Ltd., was held on December 8, 1960, in London.

Sir Joseph Ball, K.B.E. (the Chairman), in the course of his speech, said:—

The overall increase in gold production for the year ended June 30, 1960, which rose by 1,491 oz., resulted in an increase in revenue of £19,550 over the figure for the previous year. At the same time total mine expenditure increased by £23,924, although by reason of the higher tonnage milled, the unit cost of production fell by 2d. per ton. The net result, however, was an overall decrease in the mining profit of £3,756.

The Company has maintained its qualification as an Overseas Trade Corporation and is assessed for tax purposes on this basis. We are, therefore, authorized to pay dividends to non-resident Shareholders without deduction of United Kingdom income tax from that part of the dividends deemed to be paid out of exempt trading income.

An interim dividend of 1s. per share was paid during the year, absorbing a net amount of £85,750, and a final dividend of 1s. 6d. per share is recommended, which will absorb a net sum of £128,625. United Kingdom income tax payable by the company in respect of these dividends, is in the order of £129,000. The unappropriated mining profit carried forward amounts to £77,986 as compared with £75,905 brought forward from last year.

After charging to non-mining income the cost of a Jubilee bonus to mine employees amounting to £4,180, the amount carried forward from this source was increased from £13,882 to £17,722.

The adoption of electric hoisting has resulted in a reduction in costs amounting to 2s. 3d. per ton milled, of which approximately 11d. can be attributed to the Chaffers shaft conversion, and 1s. 4d. to the combined effects of the conversion of the Associated, Lake View and Ivanhoe shafts.

It now falls to me to say something to you about the future of the company, and I am afraid that some of what I have to say must necessarily be of a somewhat serious nature.

I would state at the outset that we are quite happy with the staff situation, under our new manager, Mr. R. C. Buckett, and his assistants; but I am very much afraid that the handicaps to which I propose to refer are beyond the control, either of the management in Australia, or of the board of directors in London.

Running throughout the whole of the company's history has been the constant bugbear of rising costs, accentuated as it has been especially during recent years by Australian legislation with regard to what is known as the "Basic Wage".

This legislation applies to the whole of Australia and imposes a basic wage linked with the cost of living and subject to quarterly reviews by Arbitration Courts, which are empowered to settle on their own responsibility, the wages to be paid in various industries, quarter by quarter.

This policy bears particularly hardly upon the

gold mining industry, which receives a fixed price for its product and in consequence has no opportunity of passing increased costs on to the purchasers of its product.

Between February 1949 and October 1960, the basic wage has increased from £6 12s. 9d. per week to £14 7s. 1d. per week.

In addition there were increases in 1955 in the extra rates paid to skilled and semi-skilled operators colloquially known as tradesmen, which resulted in an additional cost to the company of £A25,000 per annum, and another increase of a similar nature in May 1960, which will cost the company a further £A34,000 per annum.

I may mention that an increase of 1s. (Aust.) per week in the basic wage costs Lake View and Star approximately £2,000 per annum in Australian currency. As you know, we have during the past four years, largely by means of capital expenditure nearly equivalent to the company's issued capital, managed to keep rising costs at bay, but we now appear to be reaching the end of our tether in this respect; and in the absence of some change of policy with regard to the basic wage, or alternatively some carefully devised revision of the Gold Mining Industry Assistance Act, of 1954, it would appear that we must look forward to a period of declining profits and dividends.

But this is by no means the worst feature of the situation. Progressive rises in costs necessarily result in progressive elimination of the lower grade blocks from the ore reserve. For example, as a result of the increase of 4s. 5d. in the cost of mining and milling a ton of ore during the year ended June 30, 1951, it was necessary to eliminate from the reserve some 111,900 tons of low grade ore; and in the following year when costs rose a further 5s. 9d. per ton, 342,000 more tons had to be written off.

If this elimination of low grade blocks were to be continued too far, the position could be reached when there were too few faces available for stoping to allow of the mill being operated at its full capacity, and this in turn would result in a higher cost per ton milled.

Our profit today is only some 10s. sterling per ton and if we are in the future to be faced with quarterly rises in the basic wage on the scale which we have experienced in the past 10 or 11 years, this margin would be progressively reduced.

Shareholders may well ask what is the remedy? The answer is that this lies in the hands of the Australian Governments, both Federal and State; and must therefore necessarily remain a matter for their decision. We can only suggest possible remedies and this we are proposing to do without delay; in fact, unofficial discussions have already taken place with the Hon. E. K. Hoar, the senior Western Australian Government representative here, and we have undertaken to submit a memorandum on the subject in the near future.

In conclusion I would like to express on behalf of the Board and of shareholders generally, our warm appreciation of the valuable services rendered by the management and staff, both in Australia and in London, and by our technical advisers, The Consolidated Gold Fields of South Africa, Ltd.

The report and accounts were adopted.

## WEST WITWATERSRAND AREAS, LIMITED

(Registered in the Union of South Africa)

### INVESTMENT INCOME AGAIN INCREASED

The twenty-eighth annual general meeting was held on December 1 in Johannesburg. The following are extracts from the circulated Statement by the Chairman, Dr. W. J. Busschau:—

The net profit of £2,069,366 represents an increase of £615,816 over the previous year.

The rise in dividend income was attributable to increases in dividends received from Blyvooruitzicht Gold Mining Company, Limited, Libanon Gold Mining Company Limited, Venterspost Gold Mining Company Limited, West Driefontein Gold Mining Company Limited and Westwits Investments Limited (previously known as New Consolidated, Free State, Exploration Company Limited.)

By virtue of its holding of 799,845 Western Deep Levels "A" shares, the company subscribed for 199,961 "B" shares at a price of 40s. per share and acquired the right to subscribe during May, 1961, for a further 199,961 "B" shares at a price of 45s. per share.

Further, the company acquired from New Consolidated Gold Fields Limited for the sum of £70,761 a one-half share of that company's participation in a syndicate known as "Western Areas Prospect." Arising from the purchase of this one-half share the company received from Western Areas Gold Mining Company Limited a refund of £33,329 and subscribed at par for 139,339 units of stock of 10s. each and 218,043 shares of 10s. each, 2s. 6d. paid up, in that company. Consequent upon its participation the company has accepted an offer by Johannesburg Consolidated Investment Company Limited of a 3½% contributory participation in a syndicate known as "Western Areas No. 2 Prospect."

In May, 1960, the company's holding in West Driefontein Gold Mining Company, Limited, was increased from 1,444,006 shares to 2,888,012 shares as a result of that company's capitalization issue.

Since the close of the year the company has subscribed for 1,120,912 shares of 10s. each, at par, in Free State Saaiplaas Gold Mining Company, Limited, and has transferred 200,000 of these shares to its subsidiary, Westwits Investments, Limited, thereby making the latter's holding 2,131,050 shares. In addition to this subscription the company participated to the extent of £500,000 in a loan of £2,500,000 to Free State Saaiplaas Gold Mining Company, Limited. This loan has been fully drawn on and is repayable between July 1, 1961, and December 31, 1964.

The effect of the recent participation in the finance of the Free State Saaiplaas mine has been to reduce the cash available to meet future commitments in the issue of Western Deep Levels "B" shares to be made in May, 1961, and the balance of

the amounts to be paid on Western Areas shares as well as the further need for funds for the company's own probable drilling programme and for the participation in the Western Areas No. 2 Prospect. The company, however, expects to receive a rising stream of dividends in the future and consequently rather than raise fresh money it was considered that its needs could best be set by a short-term loan of £500,000. Accordingly the company has arranged with The National Finance Corporation of South Africa to borrow £500,000 by the issue of debentures.

### Drilling Operations

During the year under review exploratory drilling operations were continued in bore-hole E.10E on the farm Gerhardminnebron No. 139, and commenced in four new boreholes, namely, No. 21 on the farm Rietfontein No. 349, No. 22 on the farm Doornkloof No. 350 and E.8K and E.8L on the farm Kleinfontein No. 141. Borehole No. 21 penetrated the Transvaal System into lavas of the Ventersdorp System and intersected the Black Reef at a depth of 4,448 ft. assaying 11.7 dwt. over a corrected width of 6.4 in. equivalent to 75 in./dwt. At 8,490 ft. this borehole intersected the Ventersdorp Contact Reef assaying 41.2 dwt. over a corrected width of 32.0 in. equivalent to 1,318 in./dwt. This intersection, together with information from neighbouring mines, indicates that a large area to the south-east of the Libanon mine is underlain by Ventersdorp Contact Reef at mineable depth, and the high value disclosed may be of considerable significance. Further drilling is being planned to determine the full extent of this reef-bearing ground and its economic potentialities.

The company's dividend income from its shareholding in the five producing mining companies on the West Wits Line has increased steadily since 1948 and further increases in this dividend income may be expected in the future. The company's dividend income is already being increased as a result of its indirect holding in Harmony Gold Mining Company, Limited, and it is expected that within the next few years it will be augmented further from its direct and indirect holding in Free State Saaiplaas Gold Mining Company, Limited, and thereafter from its shareholdings in Western Areas Gold Mining Company, Limited, and Western Deep Levels, Limited. Accordingly an assessment of the future prospects of the company indicates that it should be feasible during the next few years to provide for the repayment of the debentures and still to make further improvements in the rate of the company's annual dividend distributions.

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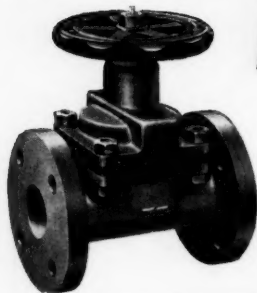
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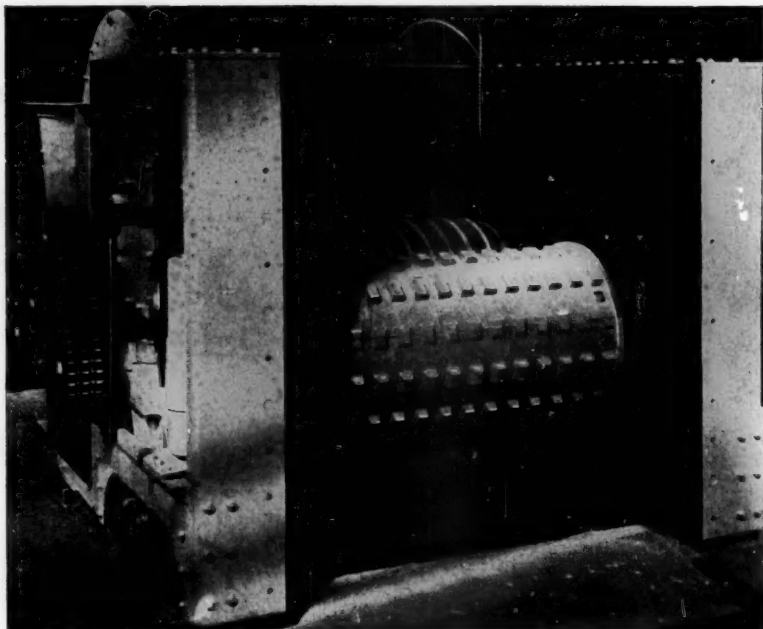
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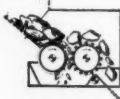
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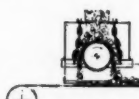
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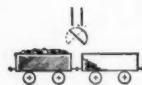
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